2009

Parking Regulation Strategies and Policies to Support Transit-Oriented Development

Ryan W. Lundergan
University of Massachusetts Amherst

PARKING REGULATION STRATEGIES AND POLICIES
TO SUPPORT TRANSIT-ORIENTED DEVELOPMENT

A Thesis Presented

by

RYAN W. LUNDERGAN

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
of the requirements for the degree of

MASTER OF REGIONAL PLANNING

Landscape Architecture and Regional Planning

PARKING REGULATION STRATEGIES AND POLICIES

TO SUPPORT TRANSIT-ORIENTED DEVELOPMENT

A Thesis Presented

by

RYAN W. LUNDERGAN

Approved as to style and content by:

____

Mark Hamin, Chair

____

Michael Dipasquale, Member

____

John Hersey, Member

____

Elizabeth Brabec, Department Head

Landscape Architecture and Regional Planning

ACKNOWLEDGEMENTS

Special thanks to my mother, Marie Mathews, who has stood in my corner since day one and always reminded me that an education is priority number one; above family, friends, and most importantly, the temptation to slack off and let your goals, dreams, and aspirations slip out of reach. I would like to thank the rest of my loving family, Jamie Mathews and James Mathews. You are instrumental pieces of an invaluable support system. I would also like to thank my committee members for their guidance, patience, and optimism while advising me.

ABSTRACT

PARKING REGULATION STRATEGIES AND POLICIES

TO SUPPORT TRANSIT-ORIENTED DEVELOPMENT

SEPTEMBER 2009

RYAN W. LUNDERGAN

B.A., WESTERN NEW ENGLAND COLLEGE

M.R.P., UNIVERSITY OF MASSACHUSETTS AMHERST

Directed by: Mark Hamin

This thesis identifies and explores the effects that new parking strategies and policies could have on transit-oriented development (TOD) success levels. Additionally, it makes the case for TOD parking regulation reform, and is designed to educate planners and stakeholders on how to successfully and responsibly shape parking regulation in the planning and implementation process, so that land use in the region allows the synergistic provision of sustainable transportation specifically to the Boston region.

Transit-Oriented Development is viewed and defined differently throughout research and literature, with its most common traits being compact, mixed use development near transit facilities and high-quality walking environments. Due to automobile dependency in the United States, developments (including TOD) are required to provide a specific level of parking to accommodate automobile usage. Excessive provision of parking decreases urban density, walkability, housing affordability, and transit ridership. In order to comply with governmental regulations and still meet TOD

goals and objectives, expensive measures such as parking garages are implemented to accommodate automobile users, leading to a less affordable development and smaller profit margins for developers.

An assessment of land use characteristics around transit stations, literature pertaining to TOD and current parking regulations and policies is conducted. Best practices and strategies are proposed with the overall goal of decreasing automobile-dependency and its impacts on the urban environment. Due to TOD's heavy reliance on extensive transit systems, the focus of the study is specifically on the 101 cities and towns in the Boston metropolitan region. Somerville, MA, which contains previous transit-oriented developments and future projects in the design process, is used as a case study for transit-oriented development.

A thing which you enjoyed and used as your own for a long time, whether property or opinion, takes root in your being and cannot be torn away without your resenting the act and trying to defend yourself, however you back by it.

-Oliver Wendell Homes

TABLE OF CONTENTS

Page

APPENDICES

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Americans today drive almost 35 percent more miles a year per capita than they did in the early 1980's (Planning Journal, May 2008, (12)). Besides consuming more gas, long automobile commutes consume more time, more infrastructure funds, more land, and more lives. By making it easier to drive longer distances, more fuel efficient cars and relatively cheaper fuel (not to mention fast food and portable electronics) have allowed people in the United States to live and work in more spread-out communities, leading to more pollution, more traffic, and more accidents. With automobile manufacturers producing more affordable models of cars, assisted by federal policies and resources that have favored automobile-oriented development, ownership of private personal vehicles has expanded and become a dominant feature in United States life throughout the last century. It has become a representation of class, opportunity, and even sexuality. With all of these factors at work, there is no wonder why the United States has more motor vehicles than licensed drivers (Pisarski 2006, 32), and more of each per capita compared with other nations.

An extensive amount of research suggests that traffic congestion and economic growth in the Boston region are closely related (Central Transportation Planning Staff Congestion Management Report 2004). Every time a person gets behind the wheel, it imposes a cost on other drivers by adding to traffic congestion. Also, it imposes costs on everyone else by adding auto emissions, increasing road maintenance, and diminishing natural resources. Currently, America loses over 3.5 billion hours a year in traffic tie-ups, and since the early 1980s it has used more than two billion gallons of fuel in such delays, which not only pollute the air but also greatly add to the costs of products and services. Federally, automobile manufacturers have been receiving windfalls from government programs. The gas tax, which taxes every gallon of gas, is placed into a trust fund and used solely to build and maintain roads. From a social standpoint, single-occupied motor vehicle traffic strangles communities and leaves the landscape increasingly covered in asphalt for roads and parking. A key question at the start of the 21st century is: how do we identify ways to reduce our overdependence on automobiles and on the infrastructure built to support it? One idea that has shown promising results in recent years is to shift away from auto oriented transportation policy and refocus on public transit. In response to these issues, there is a need for research with an aim to construct a framework for land use design standards that may help decrease automobile dependency and encourage transit-oriented development (TOD).

My objective in this thesis is to identify and explore the effects that new parking strategies and policies could have on transit-oriented development success levels. My approach is to study land use characteristics around transit stations, literature pertaining to TOD and current parking regulations and policies, and then to propose ‘best practices’ strategies with the overall goal of decreasing automobile-dependency and its impacts on the urban environment. Due to TOD’s heavy reliance on extensive transit systems, the focus of the study specifically will be the 101 cities and towns in the Boston metropolitan region.

Transit-Oriented Development is viewed and defined differently throughout research and literature, with its most common traits being compact, mixed use development near transit facilities and high-quality walking environments. It takes advantage of the opportunities provided by access to high quality public transportation. The principal aim is to boost transit ridership, and thereby boost revenue income, while also producing regional environmental and economic benefits. Community economic development and broader smart-growth agendas are also objectives (TCRP 102).

Over the past two decades, the concept of TOD has gained momentum. It has gained attention as a means to promote smart growth through focusing new construction and redevelopment in and around transit nodes. Some hope that TOD can breathe new life and vitality into areas of need by channeling public investments into struggling inner-city settings. In addition, many planners have added goals to include decreased traffic congestion, increased walkability and connectivity of the landscape, mixed use neighborhoods, and heightened overall quality of life. TOD is gaining popularity in U.S. metropolitan areas. In all but three of the 30 largest U.S. metropolitan areas, new rail or bus rapid transit systems are in some phase of design or construction process (TCRP 102).

The majority of TOD residents along new transit systems are childless singles or couples. The age spectrum is wide: often younger working professionals or older empty-nesters. TOD residents may have low, medium, or high incomes; this is driven by the design and price of the specific TOD housing. TOD developers are researching the market and proactively building products for targeted market sectors. The demographic characteristics allow developers to more finely target their product to potential end users. More higher incomes are being served as the United States continues to go through a robust construction phase of denser urban residential product. TOD households typically own fewer cars because they have smaller households and because they may forgo extra cars due to transit proximity. TOD households are almost twice as likely to not own any car and own almost half the number of cars of other households. The top three reasons households give for selecting TOD are housing/neighborhood design, housing cost, and proximity to transit. (TCRP 128)

In terms of transit mode, residents typically prefer light rail. Light rail lines often have the ability to supply a relatively higher level of service to its users with less of a nuisance while living in proximity to the stations. Aside from its lower level of sustainability, bus rapid transit often lacks services such as Wi-Fi and comfortable riding environment that light rail offers. Additionally, heavy commuter rails are hypothesized by many planners to be less inviting to live near due to their vibrations and noises created by high speeds and high weight. Armstrong (1994) studied the impact of Boston's Fitchburg line on residential property values, both in terms of amenity and nuisance values. Armstrong found that homes located within census tracts that have rail stations commanded a 6.7 percent premium for home sale prices. When he looked at the effect of proximity to the rail line itself (measured as a home being within 400 feet of the line), Armstrong found an approximate 20 percent decrease in value (Parsons Brinckerhoff 2001 (2)). Armstrong points out that although nuisance might be the leading cause, many other factors could be in play here. On the other hand, many other studies have been conducted by the Center for Transit-Oriented Development and found this data to be a national trend (Appendix).

Ten years ago it was questionable whether TODs were successful. While projects have been proposed and developed across the United States, there continue to be conflicts and consequences of the prevailing trends in automobile dependency. The automobiles effect on land form, specifically parking, has been shown to influence the degree of success for transit-oriented development. Due to automobile dependency in the United States, developments (including TOD) are required to provide a specific level of parking to accommodate automobile usage. The results are decreases in urban density, walkability, housing affordability, and transit ridership. In order to comply with governmental regulations and still meet TOD goals and objectives, expensive measures are implemented to accommodate automobile users, leading to a less affordable development and smaller profit margins for developers.

Today, evidence has shown that in many circumstances TOD can be effective in achieving its goals while remaining economically feasible. Even with the overwhelming dependency on automobiles, many strategies can be used to decrease the high amount of required or desired parking spaces. With changes in parking regulation, developments around transit stations have the potential to become more affordable to lower-income homebuyers, more sustainable, and create a safe living environment. The following study characterizes the role parking policy plays in urban form and in the success level of Transit Oriented Development. It makes the case for TOD parking regulation reform, and is designed to educate planners and stakeholders on how to successfully and responsibly shape parking regulation in the planning and implementation process, so that land use in the region allows the synergistic provision of sustainable transportation specifically to the Boston region.

CHAPTER 2

RESEARCH METHOD

Although analysis of transit-oriented development is only a few decades old, studies have recently developed clear evidence showing the benefits of being located within specific distances of efficient transit stations. In addition, TOD can be built affordably. The following chapters frame key elements, current issues, potential solutions, and roles regarding transit-oriented development. Additionally, case studies are presented that demonstrate how land uses can be improved, diminished, or otherwise affected by their surroundings. The reason for this method is that researchers have found some methods of TOD to be more successful than others, but lack sufficient evidence to pinpoint a single key factor. For example, redevelopment districts have been especially successful addressing design standards when pedestrians are in an area that is or feels safer. Methods such as traffic calming and master planning for transit-oriented development have proven as successful avenues for increasing livability as well.

One key consequence of automobile-oriented development is the extensive need for parking. Where cars are the primary means of transportation, there are comparable numbers of parking spaces. It is hypothesized that innovative parking strategies initiated within a half mile radius of transit systems may help to alleviate some of the escalating cycles of increased automobile traffic and its effects on road and parking construction. To this hypothesis, a catchment area of ½ mile around each case TOD facility will be demarcated to identify common features with regard to available parking supply. The households and housing units within that half mile radius of each existing and proposed fixed guideway transit station will be identified. Then, associated GIS files for routes, lines, and stations for each transit systems will be extracted. Data on households and housing units is from the 2000 U.S. Census. GIS data on the transit systems are primarily from the 2002 and 2004 FTA National Transit Atlas Databases, along with supplementary information from the Massachusetts Bay Transit Authority, The City of Boston, and the Boston Area Metropolitan Planning Organization Central Transportation Planning Staff.

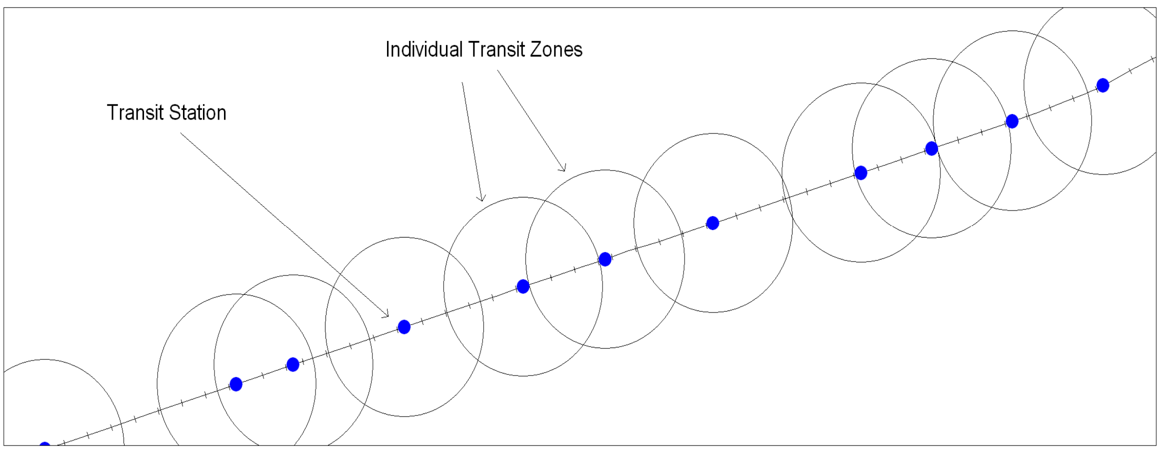


Figure 2.1: Transit Study Example

The primary source of information for this research is from the Center for Transit Oriented Development TOD Database. Originally created in 2003 and 2004, this was the primary source of information for the first ever national TOD market study conducted by the Center for TOD and reported on in *Hidden in Plain Sight: Capturing the Demand for Housing Near Transit* (HIPS), September 2004. The TOD database was created using the 2003 National Transportation Atlas Database (NTAD). Updates to NTAD were made for the HIPS report and then again for this project. These updates consisted of contacting transit agencies directly to identify and acquire GIS system data not included in the

NTAD, manually geo-referencing stations according to transit system maps, and crosschecking these against the 2004 NTAD fixed guide-way database for major differences.

GIS is the primary platform for the CTOD Database; however statistical data for the transit zones, the aggregate of the transit zones, and the transit region are in a Microsoft Access database. The database contains several pre-defined reports at the transit zone, aggregate of transit zones, and transit region levels which have been used to better define the regions surrounding transit hubs of special interest in the Boston Region. In addition to system size classification, transit systems are categorized as Existing or Potential. The database is extensive and as of 2005, there were 3,349 existing stations in 32 regions and 736 proposed stations. Currently, the existing and proposed transit regions within the database comprise summed 42 metro areas that have or will have a fixed guide-way transit system by 2010.

The GIS parking data are from a component of the Central Transportation Staff *Access to Boston 2000-2010* city-wide transportation plan. Companion reports address pedestrian safety, bicycling, public transportation and regional connections. Objectives for the document are to locate all parking both on and off street with the goal to decrease amount of parking should discourage additional auto trips that overwhelm streets without threatening individual mobility and appropriate auto access.

The analyzed data is specifically chosen at a half mile radius around transit stations due to maximum desirable walking distances for access to transit. Characteristics of the transit station radii that are specifically focused are on and off street parking availability, property values, households per acre, median and percentage of household age, form of commuter mode, and total households.

The extracted data sets are strategically focused on Somerville, Massachusetts, as a case study. Somerville provides a great example of a region that contains heavy rail and bus service, automobile-oriented policies, and a legal commitment to a light rail in the near future. Additionally, the case study demonstrates how modern transit-oriented development parking policies and strategies can be utilized to create a mode shift that increases transit ridership, walkability, density, development feasibility, and ultimately increase affordability in a region.

CHAPTER 3

HISTORICAL AND THEORETICAL CONTEXT

The Boston metropolitan area, consisting of 101 cities and towns, has specific land use issues that have created problems for populations to move readily through its transportation system. "Government policies and programs that support auto-oriented growth and sprawl synonymous with traditional growth, have resulted in major problems with housing, land use and transportation in American cities"(Richardson 2005). The effects of Boston's auto-oriented transportation system, e.g., congestion, pollution, special mismatch, and racial and economic inequality, have left transportation planners looking to earlier land use policies for explanations and potential solutions.

Over the last century, the nation's primary mode of transportation has shifted from mass transit to personal automobile, thus drastically changing Boston's land use development and growth pattern. Public transportation first emerged in the city in 1631, when Boston was a peninsula connected to the mainland by a narrow strip of land which is now the South End. With no bridges and limited access to the mainland, transporting freight by ox cart from Winnisimet (Chelsea) to Boston was a two day journey through Malden, Cambridge, Brighton, and Roxbury. People traveled within the city on foot, and rarely went beyond its borders; most could not afford horses and wagons. In 1630, the Massachusetts Court of Assistants, the Colony's Legislature, sought to improve access to the mainland by offering a charter to anyone who would run a ferry between Boston and Charlestown. A year later, Thomas Williams began what was probably the first chartered transportation service on the continent; a ferry from Chelsea to Charlestown and on to

Boston. For almost the next two hundred years, sail and row boats carried freight and passengers on the three-mile run across Boston Harbor, from the foot of Hanover Street to Winnisimet Street, Chelsea. (www.MBTA.com).

Following the Revolutionary War, because of commercial-industrial development and immigration, Boston's population began to grow more rapidly and resulting demand for housing rose dramatically. To create housing for new residents, land reclamation and infill development began to take place, land area increased, and Boston's walkability was in some respects diminished. Horse-drawn carriages emerged as first form of mass transportation across land. In 1832, New York City began to implement a test run of horse drawn carriages along fixed rail lines. Roads during this time were filled with ruts leaving passengers uncomfortable. They discovered that constructing a rail network allowed for a much smoother ride and horses could actually pull heavier loads. Although major advancements in technology began to arise, pedestrians dominated the use of roads until the end of the 19th century. For example, "Boston's citizens owned only 145 wheeled vehicles in 1798, and the streets were not only passages but also public space where vendors sold goods, children played, and neighbors met." (Childs, 1999, 3)

"Apart from its impact on road improvements in the United States, no preceding technological innovation not even the internal-combustion engine was as important to the development of the automobile as the bicycle" (Fink, 1990, 5). Bicycles began sweeping America in the 1890's. This was also the first time pedestrian/vehicle tensions were recorded. Bicycles were viewed as a menace and many were accused of speeding past pedestrians without regard for safety. In response, people began stoning bicyclists and many laid spike strips in the roadways.

Bicycle manufacturers pioneered mass vehicle assembly and a host of technical performance inventions and techniques such as steel frame tubing, ball bearings, chain drive, differential gearing, and pneumatic tire. Later, bicycle dealerships were often the first to sell automobiles (Rae 1971, 28). The bicycle age reinforced the vehicular use of the street and provided the technological and entrepreneurial resources for the refinement of the automobile. From then on, carriages and bicycles began to take over the streets, giving way to the coming of the automobile.

The social clash between pedestrians and vehicles continued into the 1900's. "In 1901, a Wall Street chauffeur driving an automobile killed a two-year-old playing in the street. Neighborhood residents assaulted the chauffeur, whom they considered to have invaded their territory. Due to the accidents occurring, William Eno wrote "Rules of the Road". Based on his writings, in December, 1903, New York City became the first to adopt extensive traffic codes. It required pedestrians to be on sidewalks, and roads to be reserved specifically for the automobiles.

As competition grew in the mass transportation business, private companies looked new forms of mass transportation to use inside Boston. After a trip to Virginia in 1889, executives of the West End Street Railway Company decided to run street cars on electric lines built above the street cars. The Boston system was one of the pioneers in street railway total system electrification on a large scale metropolitan basis. Based on the success here in Boston, many of America's larger street railway systems converted to electrification. Boston had led the way for other cities to follow. The first electric streetcar line in the "Hub" began operation on January 1, 1889 starting from the Allston Railroad Depot, up Harvard Avenue, left at Coolidge Corner to Boston's Park Square. The present MBTA's Green Line/Beacon Street was part of this first installation. (www.MBTA.com)

Despite the unprecedented steps Boston was making in mass transit, it was still attempting to handle congestion problems. "By the 1880's, Boston's Tremont Street had become so clogged with streetcars that the wags of the day retorted that it would be much quicker for a passenger to climb onto the roof of their trolley and walk over roof tops of stalled vehicles to reach their destination"(www.MBTA.com). In the 1920's, traffic congestion was one of the primary issues concerning urban planners. At the time, traffic mitigation efforts were accomplished through two ways: the creation of more roads or the creation of more rules. Many people believed that congestion was harming the economy, driving up living costs, and causing traffic accidents (Weinstein 2002). While most observers liked the idea of road expansion, others felt that placing rules, restrictions, and regulations on the roadways would ultimately solve the issue. The result of this debate during the 1920's was that neither was accomplished.

After World War I, Henry Ford offered the assembly line Model T to the masses at a price that more and more people of a burgeoning middle class were able to afford. By 1927, 15 million of these cars had been sold, with all manufacturers producing more than a million new vehicles yearly (Kunstler, 1993, p. 89).

Congestion, the root of many problems in Boston, was increased exponentially in 1956 when politicians passed the Interstate Highway System Act- which resulted in the world's largest highway network. This signaled the governments retreat on supporting public transit (Belzer and Autler 2002). In the post-WWII period, Transit systems and stations were built for auto convenience. Many were designed explicitly to work with the automobile, with the assumption that most people would drive to suburban stations rather than walking, biking or riding a feeder-bus system (Belzer and Autler, 2002). A new generation of publicly-funded transit systems took form in the 1970s. Prior to this time, private companies were the primary owners of transit systems. But in the 1970s, the federal government stepped in to keep transit afloat, as many systems went out of business. While private streetcar companies of the previous century had typically built residential neighborhoods around streetcar lines, government-funded transit agencies in the 1970s did not purchase additional adjacent land to tie future development patterns to current transit investments. The primary emphases of these public systems were relieving traffic congestion and serving trips from the suburbs to the central city. Funding for land acquisition was limited to meeting transit right-of-way needs only. Stations, characterized by large parking lots or structures, were designed around cars because it was assumed that people would drive to the suburban stations to use transit. (Richardson 2005, Goodwill 2002)

As transit related development has expanded over the past 30 years, so has the highway system. Between 1990 and 2000, the average nationwide travel time to work rose by almost 3 minutes, to 25.5 minutes. Boston, once solely dependent on transit, now finds itself currently holding the title for the most expensive highway project in

United States history (TCRP Report: 102). Despite Boston's expensive taste in automobile infrastructure, urban land form has commanded a mild shift away from automobiles and back to its' historic roots of transit.

CHAPTER 4

SOCIAL AND ECONOMIC EFFECTS OF AUTO-ORIENTED DEVELOPMENT

Overestimating the need for parking creates a region that contains less density, fragmented streetscapes, less opportunity for housing, and ultimately less access to public transportation. The cost of living for an American family consists of many components. The two largest are housing and transportation (Brookings Institute 2006). Affordable housing located near transit allows families and seniors to live an affordable lifestyle and access employment, education, retail, and community opportunities. Nationally, for every dollar a working family saves on housing, it spends 77 cents more in transportation (Center for Housing Policy 2006).

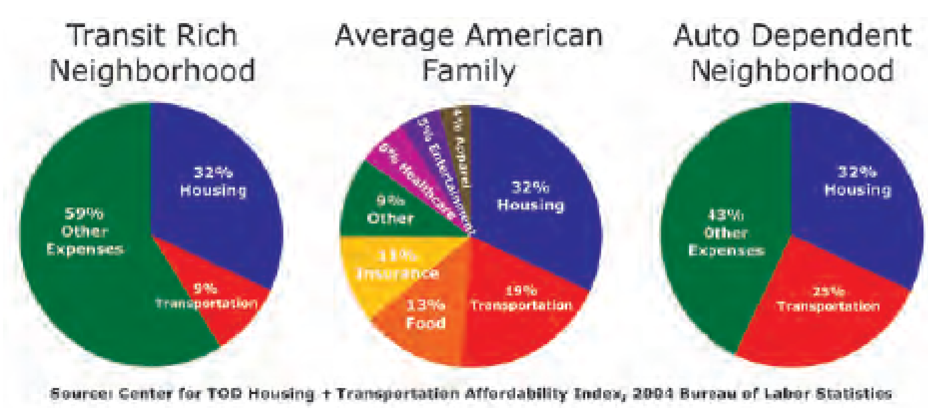


Figure 4.1: Typical Household Costs

A growing number of communities are identifying the lack of affordable housing and the increase in commute times and traffic congestion as priority issues. Families in search of affordable homes find themselves locating far from their job. Many call this “Drive ‘Til You Qualify”. The problem with driving until you qualify is that many working families efforts to save on housing expenses lead to significant increases in commute times and higher transportation costs. Many times it leads to families paying more of their budget (shown in figure 4.0). Families seeking to “qualify” end up increasing commuter traffic and strain the infrastructure. Alarmingly, of the fastest 20 growing counties in the United States, 15 are located 30 miles or more from the closest central business district. (Center for Housing Policy 2006). Additionally, families are leaving themselves more susceptible to market variations. At $3.00 per gallon, double the price of just two years ago, the average household will increase its total transportation expenditures by 14 percent, or $1,200 per year. This increase alone is 3 percent of the median income household’s annual earnings. (Brookings Institute 2006)

The National Housing Trust conducted a study of 8 cities (New York, Chicago, Boston, Portland, Seattle, Denver, Cleveland, St. Louis) and discovered that 100,000 federally assisted units are within a half mile of rail stations or proposed rail stations.

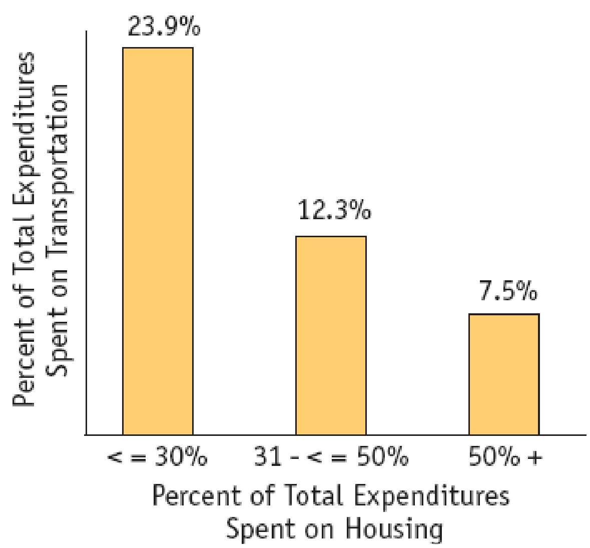


Figure 4.2: Households that Spend More of their Budget on Housing Spend Less on Transportation

The number of units near public transportation increases dramatically when frequent bus lines are created (Reconnecting America 2008).

Limiting access to public transportation in an urban area can strain its economy. While work related trips total just under 20 percent of all trips by all modes of transportation, they are the largest category of trips by transit, comprising 59 percent of total transit trips. While non-work related trips are increasing faster than work related trips, work trips continue to represent a large share of the total travel during the Monday through Friday work week, and the decisions about how to commute has a significant impact on the livability and sustainability of communities.

Transit's share of the commute varies dramatically by urban form and is highly correlated with population and employment density. In Boston specifically, transits share of the commute trip is 14 percent in the region, 49 percent into downtown, and 79 percent to jobs within a half mile radius of downtown Red Line Stops (CTOD 202). In addition, TOD households are twice as likely to not own a car and own roughly half as many cars as comparable households not living in TODs (TCRP 2008). Based on the 2000 census figures, approximately 54 percent of the population within the Boston MPO region lives within walking distance of MBTA transit service. This statistic reinforces the importance of promoting public transit use, particularly by providing a safe environment for pedestrians and bicyclists in the areas served by transit.

Although parking effects affordability, it also has its effects on sheer transit ridership. The Brookings Institute conducted a study which discovered that even among wealthy neighborhoods, neighborhood characteristics such as density; walkability; the availability and walkability of transit service; convenient access to amenities such as grocery stores, dry cleaners, day care and movie theaters; and the number of accessible jobs shape how residents get around, where they go, and how much they ultimately spend on transportation (Brookings Institute 2006).

Research on how parking requirements affect property value shows that they raise housing costs, reduce urban density, and reduce land values. In 1961, Oakland, California, began to require one parking space per dwelling unit for apartment buildings. Brian Bertha (1964) collected data for 45 apartment projects developed in the four years before Oakland introduced the parking requirement and for 19 projects in the two years later. After parking was required, the construction cost per dwelling unit rose by 18 percent, housing density fell by 30 percent, and land values fell by 33 percent. These drastic changes were due to the zoning change making prior densities impossible without underground garages. This increased the cost of development if the same development of an apartment with a higher rent structure, and in order to be able to receive higher rents in the market, the developer tried offering the tenants larger units.

Essentially, Oakland's requirement incorporated the cost of an automobile into the cost of an apartment, making car ownership more affordable and housing less affordable.

CHAPTER 5

AUTOMOBILE-ORIENTED PARKING POLICY

Managing parking may not be the end all be all for urban congestion, economic equality, and land use development issues, but it has the potential to significantly decrease automobile dependency in and around urban areas by increasing the ability to utilize transit. Although parking is costly to build, maintain, and manage, 99 percent of parking in the United States is provided free to the user (Congress for New Urbanism 2008).

Employer Paid Parking

Employer-paid parking is a tax-exempt fringe benefit you qualify for only by driving to work, and the 1995 Nationwide Personal Transportation Survey found that 95 percent of commuters who drive to work park free. Even in the metropolitan Boston area, 93% of automobile commuters park free at work (Shoup 2005). The cost of providing all this free parking is taking a toll. In 1994, American employers provided 85 million free parking spaces for automobile commuters. KPMG Peat Marwick estimated the total annual capital and operating cost of the employer-provided "free" parking spaces amounted to $52.1 billion in 1989, or about 1 percent of the gross national product.

Donald Shoup, former director for the Institute of Transportation at UCLA and Author of *The High Cost of Free Parking*, points out that some commuters will drive to work only if they can park free at work; if they have to pay to park, they will ride public transit, walk, or bike to work. Employer-parking draws commuters into cars and away from transit. Through case studies, he points out that employer-paid parking increases the number of cars driven to work by about one-third. Ultimately, free parking is distorting transportation prices in favor of solo driving, which increases congestion, fuel consumption, accidents, and air pollution. Richard Wilson, a transportation modeler and researcher, developed a model of commuter travel in Los Angeles. His model shows how parking prices affect the mode choices of commuters to downtown Los Angeles. He discovered that if commuter can park free at work, 70 percent of them drive alone, while 15 percent ride public transit and 15 percent carpool. But if commuters must pay $5 a day for parking, only 45 percent of them drive alone, while 34 percent ride public transit and 21 percent carpool. Therefore, when compared with free parking, a price of $5 a day for parking reduces the drive-alone share by 36 percent, increases the carpool share by 40 percent, and more than doubles the transit share.

Minimum parking requirements reduce the value of existing building. Suppose a building meets the requirement of one parking space per 1,000 square feet for a furniture store. The furniture store goes out of business, and a bicycle repair shop wants to use the vacant building. Because the parking requirement for a bicycle shop is three spaces per 1,000 feet, and the building only is one space per 1,000 square feet, the bicycle shop cannot obtain an occupancy permit. Minimum parking requirements thus reduce the flexibility of existing building, stymie adaptive reuse, and stifle enterprise (Shoupe, 1997 10).

Engineering also utilizes urban design standards. Pat Noyes (2008) explains that the concept of “Traffic Calming” is quickly becoming the common term for addressing a wide range of concerns that traffic engineers have grappled with for years (P.1). Traffic calming includes a number of tools to slow traffic speeds, reduce through traffic and traffic-related noise, improve aesthetic street value, and increase the safety of pedestrians, bicyclists, and motorists. Planners and engineers use the “three E’s”: engineering, enforcement, and education, all of which have enormous impacts on the community when implemented simultaneously. Noyes states it has become increasingly clear that effective traffic calming must also enhance streetscaping methods (Noyes 2008. P.2). In addition, he advises that measures taken should be addressed in a comprehensive program to ensure consistency among traffic calming applications within jurisdictions. This will in turn address traffic problems and local issues while enhancing neighborhood livability.

There are more progressive ideas which incorporate measures to severely decrease the flow of automobile traffic while increasing pedestrian movement. Rolf Monheim states that car free zones and the integration of “pedestrianisation” methods are the most visible signs of a new orientation in urban and transport planning. Furthermore, he states that the aim of “pedestrianisation is to create a more attractive urban environment” (Monheim 101). In addition, he promotes the revision of parking management issues and utilization of traffic calming methods.

Peter Calthorpe argues that physical design plays a central role in the long-term effectiveness of many efforts to renew urban life; at the same time that social and economic program remains essential. He explains that more and more cities are valued for their overall urbanity, rather than singular features. Businesses and people in a mobile economy choose locations as much for quality of life as for functional assets.

Although cities will never compete with suburbs for open-space amenities, parking convenience, and single-family housing opportunities, they can provide the vitality, mix, human scale, history, and excitement that cities traditionally offered- and that are increasingly in demand. To compete, cities must be urban in the best sense, not just dense suburbs (Calthorpe 243)

Childs claims that adding value is not simply a matter of convincing clients to spend more money, but of illustrating how a well designed parking lot will yield more value for their investment. Designers must show not only that they can provide a judicious supply of parking, but that:

1. the space can be used for multiple purposes, including revenue generation,
2. the attractiveness, safety, and security of site for clients and employees will be improved
3. neighborhood and governmental acceptance of proposed developments can be increased

(Childs 1999, xxii)

Replacement Parking

Zoning can tremendously increase parking if it's designed with a parking replacement ordinance or bylaw. Zoning increases parking through replacement parking in new developments by removing existing parking spaces. With replacement parking requirements, developers must not only provide parking spaces normally required for a new land use, but must also replace any existing parking spaces removed even if zoning never required this parking. Replacement parking requirements further increase the cost of new buildings, beyond the cost of meeting the normal parking requirements.

CHAPTER 6

TRANSIT-ORIENTED POLICIES TO DECREASE PARKING DEMAND

Factors that most influence transit ridership are station proximity, transit quality, and parking policies. Fast, frequent, and comfortable transit service will increase ridership, as will high parking charges and/or constrained parking supply. The availability of free or low-cost parking is a major deterrent to transit ridership and must be addressed. Successful ridership strategies include: TOD transit pass programs, parking reductions, car sharing programs.

TOD is still illegal around station areas in many cities and transit districts, creating a barrier for development. Steps that transit agencies are taking to promote TOD include: reconsidering replacement parking requirements at park and rides and transit stations, advocating for zoning changes with TOD entitlements, land assembly, joint development, parking restrictions, and bicycle parking mandates.

Transit stations in town, village, and city centers create a unique set of parking challenges that require their own set of solutions, possibly including pricing structures and "first mile" shuttle services for nearby residents. As these problems persist, parking becomes increasingly expensive (Table 6.0). More innovative and flexible approaches such as shared parking, leased spaces, valet services, shuttle services, and car-sharing can increase parking availability while allowing development. Before adding capacity through new lots or garages, towns need to manage their existing parking supply more efficiently. Pricing, signage, education, and enforcement are all important tools to do this.

Generally, localities govern parking through minimum parking requirements, which require a certain amount of parking based on number of bedrooms or units or per square feet. Parking reductions can either take the form of reduced minimum parking requirements or maximum parking requirements.

Table 6.1: The cost of a new parking space compared with price of a new car

Year built (1)	Cost per parking space (2)	Average price of new car (3)	Space cost as % of car price (4)=(2)/(3)
1961	$ 2,000	$ 2,841	70%
1963	$ 1,626	$ 2,968	55%
1964	$ 1,946	$ 2,954	66%
1966	$ 2.323	$ 3,070	76%
1967	$ 2,789	$ 3,212	87%
1969	$ 2,907	$ 3,557	82%
1977	$11,762	$ 5,814	202%
1980	$11,499	$ 7,523	153%
1983	$19,752	$10,640	186%
1990	$20,859	$16,162	129%
1990	$22,350	$16,778	138%
1991	$20,873	$16,778	124%
Average 1961-1969			73%
Average 1977-1991			155%

From a design perspective, parking ratios largely determine if there is space for retail, child care or other non-residential uses. From a cost perspective, parking is both a driver of the initial development budget and a key factor in determining longer-term housing prices. According to the 1997 study for the San Francisco Planning Department, housing without parking spaces was more affordable and sold faster than housing with a parking space. While this does not guarantee that lower-income households will benefit from lower parking requirements, it greatly increases the odds.

Value Capture

Rising construction costs and competition for scarce federal dollars make it increasingly difficult to fund transit systems and or system expansions. Increasing density in a development does not always correlate with increased profits for the developer. The center for Transit-Oriented Development constructed graphs showing the potential relationship between density and expected developer profit for a range of building types.

In many of the developments, profits are not very high enough to offset the construction costs of the building. For example, revenues for a “Dallas Donut” apartment complex (an apartment building wrapped around an internal parking structure) is not enough to offset the costs of the build. This results in the developer losing money on the development, thus making it less attractive to built. One of the key reasons why developments become so costly during construction is parking. Surface parking can cost from $5000 per space for low-end asphalt to $10,000 with details like cobbles and brick pavers. Parking tucked under a townhome can cost about $14,000 a space.

Lowering parking ratios can have a major impact on development feasibility, since the cost to build a structured parking garage can range from $20,000 to $50,000 per space. Consider a simple one-acre parcel zoned for up to 100 units of residential development: A parking requirement of two spaces for every residential unit may dramatically limit the total number of residential units that will actually be developed because the parking alone will consume 320-350 square feet per space at a cost of $20,000 to $40,000 per space. By simply reducing the requirement to 1:1, the development can now address all of its parking requirements with a structured

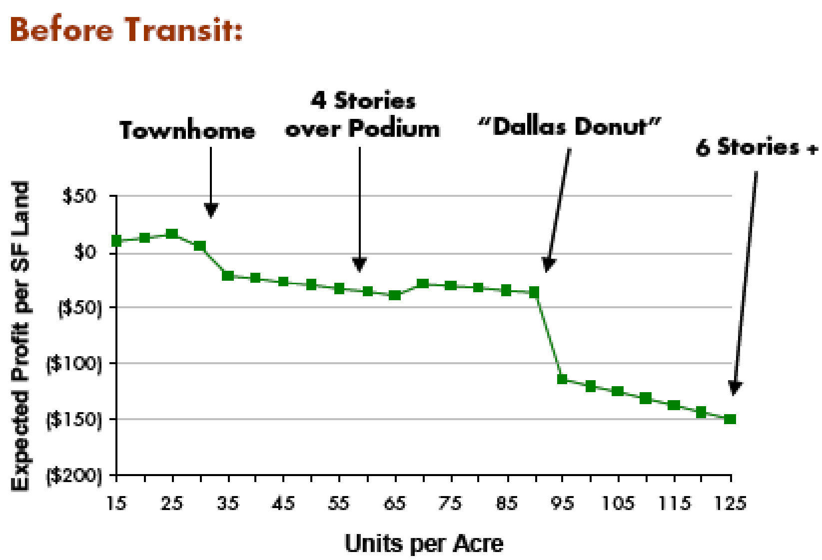
Table 6.2: Land Use and Parking Cost

	Units Gained	Spaces Saved	Capital Cost Savings
Garden Apartments	60	144	$98,000 5%
Town Homes	96	200	$736,000 11%
Mid-Rise 6 Story	162	648	$12,000 36%
Texas Donut	225	288	$5,300,000 25%

ground floor parking garage, saving the development as much as $2 million. By reducing the requirement to .75:1, the development now has enough ground floor space for a child care center and 10,000 square feet of retail. Below is an estimated savings cost table to significantly lowering parking ratios.

Proximity to transit also makes it possible to charge higher rents or sales prices. In comparison to the first chart, figure 6.1 shows the difference transit can make in the ability to have return on a development. (CTOD *Capturing the Value of Transit, 2008)*

Figure 6.1: Expected Land Uses Profits before Transit (continued on to next page)



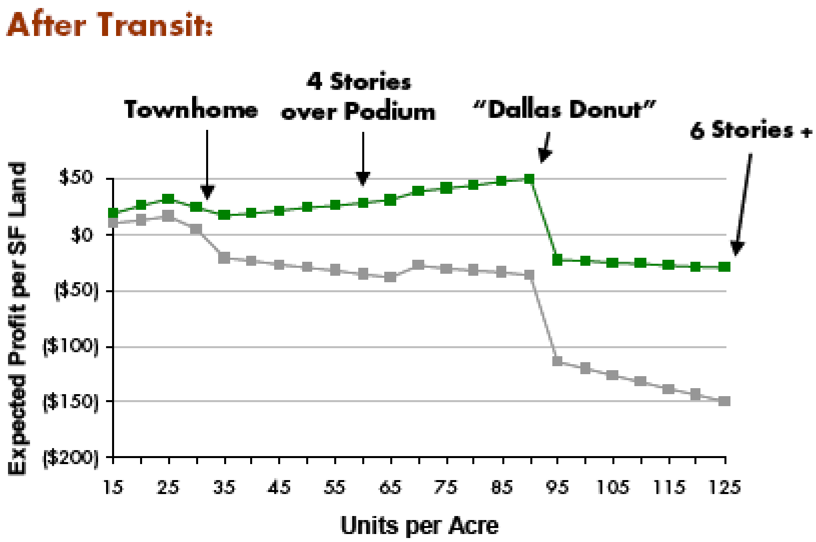


Figure 6.1: (continued from previous page)

Parking Meters

The utilization of Parking Meters is a valuable tool for decreasing the amount of automobile usage in a region around transit. On average, meters return $2.80 for every dollar spent to install and maintain them, and three tickets are issued for every meter per month (Kuzemka 1997). With the development of innovative parking regulation systems such as electronic prepaid cards, parking can be utilized in a more business friendly and accessible manner. For example, New York City instituted a program in 1998 which aims to reduce double and illegal parking by providing commercial drivers with prepaid electronic cars that allow them to pay for only the exact number of minutes they park at a meter.

Portlands TriMet initiated a TOD Pass Program in September 1998 at four TODs in Westside suburbs in conjunction with the startup on the Westside LRT project. Alongside this project were a number of parking meters installed. Assessment of the projects success showed a decrease of single occupied vehicles of 7 percent. In addition, transit use increased 12 percent. A year after construction, a follow-up survey was given to transit riders. Twenty-five percent of the respondents claimed their primary change in mode was due to personal changes in lifestyle and 22 percent noted the parking changes.

Although parking is quite hazardous to the environment and creates serious transportation tie-ups, it's very difficult to overcome its presence. Many people oppose the idea of charging for parking. In some fields, parking can be regarded as a sign of rank or status symbol. CEO's of companies often have well labeled parking spaces reserved closely to their office, far away from the average employee.

Restrictive Parking

Some cities use zoning to regulate parking by mandating a minimum number of parking spaces for a given floor area for each possible use of the property. These requirements are usually expressed as the number of parking spaces required per 1,000 feet of floor area. The most striking finding is that parking requirements for office development, which are so prevalent in suburban areas of the U.S., are uncommon in Large U.S. downtowns. Instead, the amount of parking being developed appears to be determined primarily by the need of tenants and their clients and not by minimum parking regulations. And in several instances, the city is rationing the amount of space that can be allocated for parking by using maximum ratios or caps on the total amount of downtown parking (Gerard, Mildner 2007).

Restricting the amount of parking at transit stations can help to lower the number of transit employees who drive to work. Based on the experiences of the typical

California TOD office worker, the models showed with 25 feeder buses per day, a work place with 50 percent more parking spaces than workers and no employer help with transit costs, just 9 percent of office workers near a California rail station are likely to commute by transit. On the other hand, a worker leaving a station with 400 daily feeder buses and heading to a worksite where the employer provides a transit pass or assistance toward one and offers just one parking space for every two workers, the likelihood the worker will commuter by transit is 50 percent. (TCRP 102, 21)

California has created a parking cash-out law to create a possible solution to many of these problems. The state gives commuters the choice between a parking subsidy or its cash equivalent. This policy raises the effective price of commuter parking without charging for it. The cash option converts employer-paid parking from a matching grant for driving to work into a cash grant for commuting.

Looking at the benefits of mobility, reduced congestion, and higher property values for the U.S. overall, Lewis concluded that for each $1 invested in transit services, the public realizes $5 in cash savings (Lewis, 1999).

A study concluded that the total benefits of reduced wait times as a result of transit in the New York Metropolitan area equaled $3.7 billion per year (Anas, 1993)

TOD zoning districts

The national survey of U.S. transit agencies revealed that besides standard zoning, the tools most frequently used to leverage TOD are funding for station area planning and ancillary capital improvements; the introduction of density bonuses, sometimes used to encourage the production of affordable housing units; and relaxation of parking standards.

In the case of affordable housing, senior developments or developments that are intentionally developed to serve disabled people or the homeless, local governments can put in place deed restrictions or conditions of use that assure concerned neighbors that there will be long-time uses worthy of reduced parking standards. Because parking requirements can be a source of contention during the entitlement process, reduced parking reductions on a project-by-project basis. For many developers, the cost of seeking such a reduction may not be worth it if it engenders significant community opposition.

Car sharing zoning districts are also used to reduce parking demand. The use of pay-per-use cars or car sharing is being used in many metropolitan areas. The zoning code can be changed to reduce parking requirements for developers that include car sharing facilities. The transit agency or local government could also help lower the need for parking by providing spaces for car sharing in publicly owned lots.

Parking Benefit Districts

The proper use of parking benefit districts is designed to greatly reduce the level of congestion by granting neighborhood a valuable, income-earning property-curb spaces. As a result, residents would begin to see curb parking through the eyes of a parking lot owner. Charging nonresidents for curb parking would be politically acceptable not because everyone has been convinced that paying for parking is good public policy, but because residents want the revenue to improve their own neighborhoods. The reciprocal nature of the payments- you pay to park in my neighborhood, but I pay to park in your neighborhood- should help to make paying for parking seem fair (shoup 1997, 14).

Elimination of minimum parking requirements

The option to build without providing parking will encourage adaptive reuse of older buildings, and infill development on sites where providing parking is difficult. It will also encourage land uses that rely on pedestrian and transit access, and the offer shopping opportunities for nearby neighborhoods. Land uses with fewer parking spaces will generate fewer automobiles trips, another desirable feature for nearby neighborhoods.

Eliminating parking requirements will not produce benefits overnight. The long-term benefits will occur only after the supply and demand for parking have adjusted to user-paid prices that cover the full cost of providing parking spaces. Nevertheless, residents who (collectively) own and profit from curb parking should quickly come to welcome nearby development that has little off-street parking, because it will increase the demand for what they sell to non residents-curb parking.

CHAPTER 7

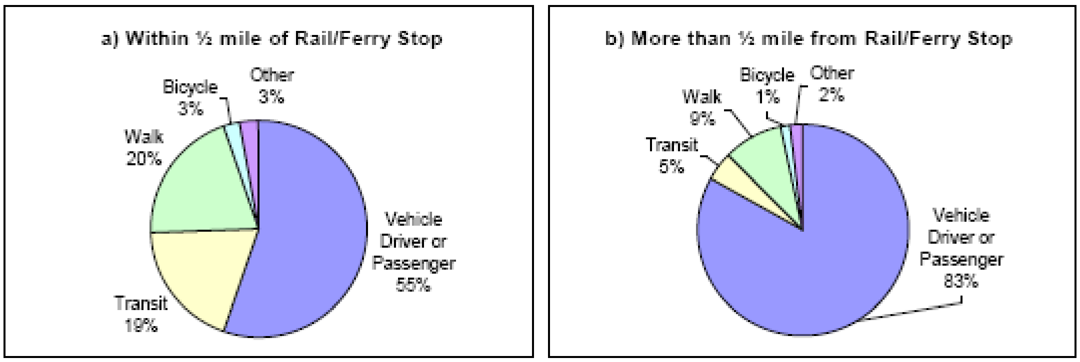
TRANSIT-ORIENTED DEVELOPMENT AND PARKING DEMAND ESTIMATES

Although the general outcomes of TOD have been successful, their overall potential has not been achieved. TOD housing produces considerably less traffic than what is generated by conventional development, yet the way parking is designed for most TODs is based on the assumption that there is little difference between TOD and conventional development with respect to the traffic they generate and the parking spaces they demand. One likely result of this fallacious assumption is that fewer TOD projects may get built. TOD projects may be more affordable and more sustainable if developers and local planners employed more accurate expectations for traffic that TODs typically generate. The value of the policy (e.g. less automobile travel) is well understood. Those potential benefits are limited since most US TODs are located at rail stops with parking regulations that fail to appreciate the potential impact of a nearby transit stop.

In 2000, a study was released regarding rail and ferry station residents in the San Francisco Bay Area. According to the Bay Area Travel Survey (BATS2000), people living within ½ mile of a rail or ferry station are four times more likely to use transit (figure 1) than people living farther than½ mile from a rail/ferry stop. In addition, individuals living and working within ½ mile of a rail/ferry stop use transit for 42% of their work commute trips. Individuals who neither live nor work within ½ mile of a station use transit for only 4% of their work commute trips. It is also important to note that those people who live within ½ mile of rail or ferry walk half of all their short trips

(trips of up to one mile), compared with only about one quarter of such trips walked by residents outside this range.

Figure 7.1: Mode of Transportation Usage within Proximity to Transit



Source: Bay Area Travel Survey 2000

For short trips, walking is generally faster than driving. This is true for trips up to one-third to one-half mile, but this is influenced by a number of conditions, such as directness of the walking and driving routes, traffic density, and walking speed. The distance that people are willing to walk is influenced by their physique, their age and stamina, their cultural habits, the purpose of the trip, the microclimate, and the form of the path (Childs, 1999, 90). Average sustained walking speeds range from 2.5 to 6.0 feet per second (AASHTE 1990, 114). The elderly and small children have the slowest walking speeds. They are also at the greatest risk of injury if they are struck by an automobile. A speed of 2.2 ft/s was found to be the most comfortable speed for 85 percent of people over 70. Children's speeds vary considerably. Currently, Americans are willing to walk about 6 minutes for errands and other short trips. Walking distance speed multiplied by time. Others find that the degree of weather protection is the most critical variable. For example, walking distances could be dramatically shortened during a snow storm, or severely hot or cold temperatures.

A walking catchment for a transit station should be designed to study the amount of people within a radius can gain access to it by foot. Generally, the radius of a catchment is the distance that only 5 to 15 percent of the population would exceed. That is, only 1 to 3 people out of 20 would walk further than the catchment radius. The table below summarizes the findings of numerous professionals' studies on walkable communities. (Childs, 1990, 90)

Table 7.1: Walking Catchment Distances

Distance	Activity	Source
300 feet	Close parking at shopping centers	Lynch 1971, 333
500 feet	70% of American willing to walk up to 500 feet for daily errands	Untermann 1984
600 feet	Peak parking for shopping centers	Lynch 1971, 333
900 feet	Average length of walk to plaza	Lieberman 1984
10000 feet	Parking fo work	Lynch 1971, 341
1500-2000 feet	Max. walking distance in park-and-ride	*Traffic Engineering Handbook*
2000 feet	"Comfortable walking distance"	Calthorpe 1993, 56
1/2 mile	Walk to transit stop	Puchkarev and Zupan 1975
3000 feet	80% of trips less than 3000 ft	Puchkarev and Zupan 1975
1 mile	Walk to work	Puchkarev and Zupan 1975

Looking at this data collected, a transit-oriented development should cater its parking policies, studies, and regulations to within a ½ mile radius.   According to Puchkarez and Zupan, most people will walk up to a half mile for transit use. Furthermore, Childs explains that the longer people are planning to stay in one particular destination, the longer they are willing to walk. What can be extrapolated is that people during their daily commute are going to stay at that destination all day and may be willing to walk much further to gain access to transit than actually estimated.

Robert Cevero, a prominent transportation researcher, studied eight residential TOD site plan cases to test some of the physical implications of reducing residential parking ratios at a range of potential densities on a theoretical eight acre TOD. His findings were that under the right conditions, lowering residential parking ratios by 50% for TODs in station areas with quality transit service can result in an increase between 20% to 33% in the potential density of a residential TOD, savings from 5% to 36% on residential parking costs and potentially greater developer profits and/or increased housing affordability from achieving higher densities, lower capital costs for parking, and reduced traffic fees (TCRP 128).

Cervero concluded that 'rightsizing' parking ratios and traffic generation to the actual performance of a TOD would likely result in important implications for physical form and performance of TOD developments. Local officials and neighborhoods would be more apt to support increases in residential densities near transit if research showed that TODs result in fewer trips than conventional development. In turn, TOD developers would have easier development approvals and so the benefits of TODs would not be thereby compromised away. Developers would also pay lower traffic related impact fees and exactions. Those savings could then be passed on to consumers as lower housing costs. With lower levels of traffic generated from TODs, it could then be argued that it makes little sense to construct roadway improvements for TOD-related traffic that is not likely to materialize. There is also the potential for higher densities in TOD because of the decreased amount of land dedicated to parking and the reduced cost of parking.

Cervero conducted extensive research on the residents of California TODs and their travel behavior, studying over 6500 housing units in 26 large housing projects built within one-quarter mile of urban rail stations between 1985 and 1994. He found that most TOD residents are young professionals, singles, retirees, childless households, and immigrants from foreign countries. Also, these groups require less housing space than traditional “nuclear families” and are more likely to live in attached housing units for financial and convenience reasons, regardless of where the units are located. Most importantly, he found that TODs had an average of 1.66 people and 1.22 vehicles per household, compared to 2.4 people and 1.64 vehicles for all households located in the same census tracts. Whereas only 48% of all households in the census tracts had fewer than two vehicles, 70% of TOD households in the census tract had fewer than two vehicles.

According to the Bureau of Transportation Statistics, in 1998 the average household spent 33% of its income on housing and 19% on transportation; it’s very important for transit-oriented developments to provide housing that is affordable for all income levels.   Perhaps the most challenging aspect of high-density TOD is the pricey structured parking that accompanies it. A real-estate development economist involved with TOD planning along the T-REX corridor in Denver has remarked: “you have to get the land values up to support structured parking. That costs $15,000 a parking space, but add special features like a ‘retail wrap’ to the garage and streetscape improvements, and you're looking at $23,000 to $25,000 a space" (TCRP 100). "It's a legitimate argument. Parking spaces in structures can cost from 10,000 to 30,000 each, compared to about 5000 per space for surface parking. The increased costs can negatively affect the financial feasibility of projects, even if they're otherwise profitable" (Caltrans 2002).

Belzer and Autler assert that TOD must have a framework that focuses on the functional outcomes of TOD, not just the physical characteristics. The marriage of physical and functional through design is valid in principle, but in order to evaluate the functional outcomes, one must look at how physical characteristics have guided the project. Parking is one of the biggest stumbling blocks for TOD, and many developers, lenders, and local governments do not consider the option of reducing parking or other strategies to achieve that goal. Lenders may not finance a project if it does not contain a standard parking ratio, but standard ratios may not accurately reflect the local conditions. Projects have been halted abruptly or resigned to lower densities due to a perception that dense development will flood surrounding streets with traffic.

Part of the problem lays in the inadequacy of current trip generation estimates, which are thought to significantly overstate the potential auto impacts of TOD. Currently, municipalities generally require minimum number of parking spaces according to the square footage and uses of a proposed building. Banks, the Federal Housing Authority, and other lenders often have their own minimum parking standards that must be met in order to receive a loan, and as a rule, business owners firmly believe that more parking space equals more profit. The standards, both cities and business owners have relied on national parking demand studies. The International Traffic Institutes (ITE) *Parking*

Generation Manual and the Urban Land Institutes (ULI) Shared Parking Manual are the major references for estimating demands. Unfortunately these have serious limitations. The ITE trip generation and parking generation rates are highly complex with many variables and can be difficult to obtain accurately. In addition, the standards from which local traffic and parking impacts are typically derived, and impact fees set are not always aligned with its surrounding land uses.

Analysts Donald Shoup explains that ITE data is actually derived from suburban areas and are not applicable for high density TODs. The ITE Parking generation book reports a parking generation rate for 64 different land uses, from airports to warehouses. The parking generation rate for each land use is defined as the average peak parking demand observed in case studies: a vast majority of the data is derived from suburban developments with little or no significant transit ridership. The ideal site for obtaining reliable parking generation data would contain ample, convenient parking facilities for the exclusive use of the traffic generated by the site. The problem here is that half of the reported parking generation rates are based on four or fewer case studies. And 22 are based on a single case study. The case studies do not refer to parking prices, but most parking must be free because the 1990 Nationwide Personal Transportation Survey found that parking is free for 99 percent of all automobile trips in the United States. The ITE parking generation rates therefore measure peak demand for free parking observed in a few case studies conducted in suburban locations with little or no public transit (Shoup 1997, 4). Planners count the cars parking at existing land uses, identify the highest number counted as peak demand (without consideration of price), and then require developers to supply at least that many parking spaces (without consideration of cost).

The Transportation Cooperative Research Program conducted a traffic study of 17 TOD housing projects, which measured daily vehicle trips. Traffic counters measuring daily volume were compared to the estimated trip generation provided by ITE which is used by the government and developers. Comparisons in the study were drawn using the ITE manual's weighted averages as well as estimates derived from best fitting regression equations. Additionally, results were cross-classified among sampled projects in terms of distance to central business districts, distance to the nearest station, parking provisions, and other factors including the quality of walking environment. Findings were that TOD housing projects generated around 47% less vehicle traffic than that predicted by the ITE manual (3.55 trips per dwelling for TOD-housing versus 6.67 trips per dwelling unit by ITE estimates) (TCRP. 102).

Table 7.2: TOD Housing and ITE Vehicle Generation Rates

		Average Rate			Regression Rate		
	Veh. Trip Rate (PM peak hr.)	ITE Rate (PM peak hr.)	TOD rate as % of ITE Rate (PM pk hr.)	% Below ITE Rate	ITE Rate (PM peak hr.)	TOD rate as % of ITE Rate (PM pk hr.)	% Below ITE Rate
Philadelphia/NE NJ							
Gaslight Commons	0.460	0.67	68.66%	-31.34%	0.688	66.90%	-33.10%
Station Square	0.558	0.67	83.25%	-16.75%	0.651	85.73%	-14.27%
Mean	0.51	--	75.96%	-24.04%	0.67	76.32%	-23.68%
Std. Dev.	0.07	--	10.32%	10.32%	0.03	13.32%	13.32%
Portland, Oregon							
Center Commons	0.380	0.67	56.75%	-43.25%	0.661	57.53%	-42.47%
Collins Circle	0.105	0.67	15.65%	-84.35%	0.741	14.14%	-85.86%
Gresham Central	0.461	0.67	68.82%	-31.18%	0.795	58.03%	-41.97%
The Merrick Apts.	0.170	0.67	25.41%	-74.59%	0.695	24.51%	-75.49%
Quatama Crossing	0.487	0.67	72.63%	-27.37%	0.625	77.91%	-22.09%
Mean	0.32	--	47.85%	-52.15%	0.70	46.42%	-53.58%
Std. Dev.	0.17	--	25.85%	25.85%	0.07	26.32%	26.32%
San Francisco Bay Area							
Mission Wells	0.487	0.67	72.72%	-27.28%	0.645	75.56%	-24.44%
Montelena Homes	0.202	0.67	30.17%	-69.83%	0.693	29.16%	-70.84%
Park Regency	0.435	0.67	64.93%	-35.07%	0.621	70.10%	-29.90%
Verandas	0.367	0.67	54.78%	-45.22%	0.662	55.43%	-44.57%
Wayside Commons	0.337	0.52	64.72%	-35.28%	0.586	57.47%	-42.53%
Mean	0.37	--	57.46%	-42.54%	0.64	57.55%	-42.45%
Std. Dev.	0.11	--	16.53%	16.53%	0.04	17.98%	17.98%
Washington							
Avalon	0.370	0.67	55.26%	-44.74%	0.635	58.28%	-41.72%
Gallery	0.234	0.67	34.89%	-65.11%	0.676	34.59%	-65.41%
Lennox	0.220	0.67	32.90%	-67.10%	0.643	34.28%	-65.72%
Meridian	0.056	0.67	8.33%	-91.67%	0.638	8.74%	-91.26%
Quincey	0.201	0.67	30.06%	-69.94%	0.635	31.71%	-68.29%
Mean	0.22	--	32.29%	-67.71%	0.65	33.52%	-66.48%
Std. Dev.	0.11	--	16.69%	16.69%	0.02	17.55%	17.55%
Unweighted Average	0.391	0.661	62.10%	-37.90%	0.664	49.42%	-50.58%

Note: Fitted Curve Equation for Apartments: T = 0.60(X) + 17.52 where T = average vehicle trip ends and X = number of dwelling units
Fitted Curve Equation for Condominium (Wayside Commons): T = 0.34(X) + 38.17

In the table above, the Transit Cooperative Research program compared TOD housing and ITE vehicle generation rates for P.M. peak estimates. It suggests that the greatest variations in TOD auto-trip generation rates are determined by metropolitan area/rail systems. Specifically, TOD-housing that is located closest to central business districts. For example, Metropolitan Washington, which contains one of the nation’s worst traffic conditions, most extensive modern-day railway networks, and densest TOD housing projects, had the lowest auto-trip generation rates.

To more accurately compare ITE rates, a weighted average was completed. Over a typical weekday period, the 17 TOD projects surveyed averaged 44 percent fewer vehicle trips than estimated by the ITE manual. The weighted average differentials were even larger during peak periods: 49 percent lower rates during the AM peak and 48 percent lower rates during PM peak. One can infer from the study that traffic impact studies might end up overstating the potential congestion-including effects of TOD-housing in large rail-served metropolitan areas by as much as 50 percent.

Predicting trip rates for morning peak hour, the output reveals that trip generation decreases in proportion to increased residential density and increases with project parking supply. The combination of higher densities and lower parking supplies holds promise for driving down morning vehicle trips for transit-based housing.

Table 7.3: AM Peak trip generation rate for TOD housing projects

	AM Peak Rate			
	Coeff.	Std. Err.	*t* Statistic	Prob.
Residential Density: Dwelling Units per Gross Acre within ½ mile of station	-0.012	0.006	-1.961	.075
Parking Supply: Parking Spaces per Dwelling Unit	0.106	0.070	1.507	.154
Constant	0.250	0.116	2.152	.039
Summary Statistics: *F* **statistics (prob.)** = 3.800 (.048); *R* **Square** = .352; **Number of Cases** = 17				

Because planners base minimum parking requirements on the peak demand for free parking, the result is usually a surplus of parking spaces, which explains why motorists can park for free 99 percent of all automobile trips in the United States. Minimum parking requirements provide subsidies that inflate parking demand, and this inflated demand is then used to set the minimum parking requirements. Because of circular reasoning, free parking requirements that meet the peak demand for free parking are, in reality, free parking requirements. Parking requirements in zoning ordinances implicitly assume that cars and people come in fixed proportions. The requirements are often stated in parking spaces per person. Thus, specifying the ratios of cars to people with the assumption that all parking is free.

Because motorists pay nothing for parking, they own and use cars as if parking costs nothing. When citizens object to congestion, planners restrict new development to reduce traffic. That is, minimum parking requirements force development to subsidize cars, and planners must then limit the density of cars. Free parking has become the arbiter of urban form, and cars have replaces people and buildings as zoning's real density concern. Minimum parking requirements implemented by urban planners has helped auto-mobilize America. Planners supposedly base parking requirements on parking demand, but they act as if this demand were immaculately conceived. (Shoup 1997, 13)

CHAPTER 8

CASE STUDIES

The Boston metropolitan region is home to nearly three million people and covers roughly 1,400 square miles. Made up of 101 cities and towns it is a sprawling region. Nearly half of all households lived more than 20 miles from the central business district in 2000, and nearly one in five households lived more than 40 miles away, the highest percentage among the nations top 100 metropolitan areas. Yet, the region is well served by transit, having one of the oldest and most extensive transit networks in the country. Eighty percent of the city's jobs; 56 percent of the city's homes; and, 51 percent of the city's schools are located within one-quarter mile of a commuter rail, bus or subway stop. Parking in the region is a major problem as its need is increasing exponentially. For all the neighborhoods in Boston, parking has increased by 47%.

Table 8.1: Resident Parking Permits Issues in 1990 and 2000 by Neighborhood

Neighborhood	Coverage of RPP Program	Permits		Change (1990-2000)	
		FY1990[1]	FY2000[1,2]	Permits	Percent Change
Allston/Brighton	Streets in specific districts	8,329	15,631	7,302	88%
Back Bay	All or most of neighborhood	5,572	7,086	1,514	27%
Bay Village	All or most of neighborhood	440	537	97	22%
Beacon Hill	All or most of neighborhood	3,602	3,933	331	9%
Charlestown	Streets in specific districts	745	4,235	3,490	468%
Chinatown	All or most of neighborhood	601	750	149	25%
Dorchester	Streets in specific districts	1,546	1,037	-509	-33%
East Boston	Streets in specific districts	5,342	7,216	1,874	35%
Fenway/Kenmore	All or most of neighborhood	3,869	4,678	809	21%
Hyde Park	Specific streets	-	14	14	
Jamaica Plain	Specific streets	1,765	2,606	841	48%
Leather District	All or most of neighborhood	67	169	102	153%
Mission Hill	All or most of neighborhood	1,588	2,002	414	26%
North End	All or most of neighborhood	3,387	4,163	776	23%
Roslindale	Streets in specific districts	-	214	214	
Roxbury	Specific streets	-	258	258	
South Boston	Streets in specific districts	901	1,226	325	36%
South End	All or most of neighborhood	7,101	9,678	2,577	36%
West Roxbury	Specific streets	-	397	397	
TOTAL		**44,855**	**65,830**	**20,975**	**47%**

Source: City of Boston, Office of Parking Clerk

Note: 1. Fiscal year 1990 begins July 1, 1989 and ends June 30, 1990; Fiscal year 2000 begins July 1, 1999 and ends June 30, 2000.

2. 1,253 permits were temporary, rental, motorcycle, or dealer permits were issued in FY2000. These permits were distributed proportionally over each neighborhood for comparative purposes with the FY1990 data.

Source: Parking in Boston, December, 2001

Case studies of the Somerville transit system demonstrate how current land uses surrounding transit stations exemplify characteristics of transit-oriented and auto-oriented land use. In addition, suggested changes in parking policy and regulation are made for future development in the area so that transit-oriented development is a key focus. The study looks at three different transit lines that travel through Somerville, MA in the Boston Metropolitan region; the orange, green, and red line. The orange line demonstrates a transit stations' ability to contain significant auto-oriented land uses that is directly related to parking. Issues such as connectivity, spatial mismatch, and low density are all consequences displayed around the orange line. The consequence of these issues is an increase in automobile usage. Furthermore, the negative relationship between automobile ownership percentage and commuter transit ridership is exemplified within its half mile radius. The Red Line transit station, Davis Square and Porter Square, are prime examples of high density transit-oriented developments that contain high commuter transit ridership percentages but are plagued by lower housing affordability due to a gamut of reasons including high parking ratios.

Somerville, MA

The City of Somerville, MA is undergoing a major transformation as new private development projects and improved mass transit access move forward. These include the Assembly Square Development with a new Orange Line Station and the Green line extension from the existing Lechmere Station through Somerville to Medford, resulting in the construction of several new rapid transit stations. It's imperative that existing transit station land uses are studied to formulate lessons learned so that future development may be planned responsibly and sustainably for the current and potential populations of Somerville.

Somerville is a mature suburb of Boston and has been built out for over 50 years. Since 1990, the median household income in the City of Somerville has risen faster than the regional average, with a 43 percent increase in Somerville compared to a 30 percent increase in the region as a whole. Yet despite this faster increase, the median income in the City of Somerville was still about 88 percent of the regional median.

According to the 2000 census data the median age in Somerville is 31 and the number of residents under 24 fell from 1990, thus signaling a decline in families. The majority of the population in Somerville is between 25-54 and over 85 years old. At the same time that these demographics groups have grown in Somerville, the State of

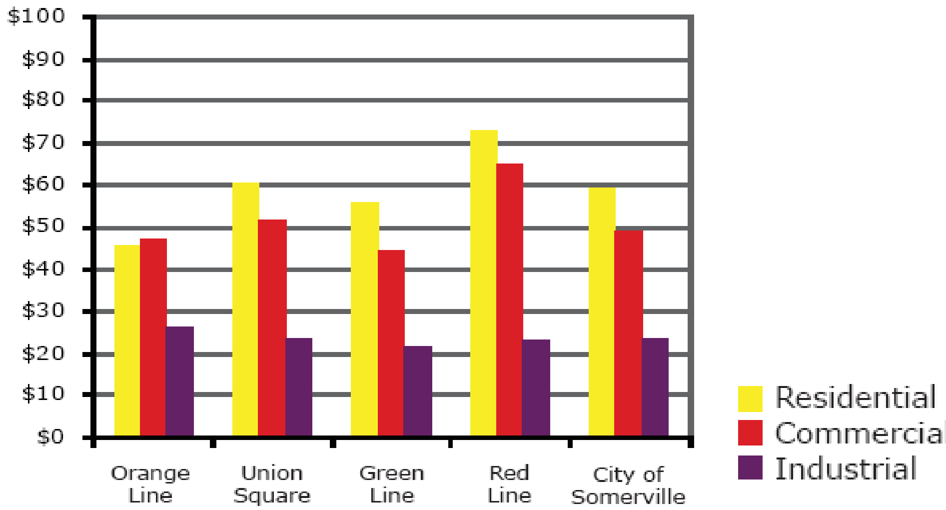
Massachusetts has lost a large percentage of this population. Interestingly, the fastest decline in Somerville is in the 55-85 or baby boomer population, contrary to the fact that this population is growing nationally.

Minorities account for 27 percent of the population; 29 percent of the population is foreign born; and 9 percent of the population includes limited-English speakers. This translates into nearly 19,000 residents per square mile, with approximately 1461 limited-English speaking residents per square mile. The City of Somerville High School reported that in the 2004-2005 school year, over 50 percent of the students 9-12 spoke a language other than English as their primary language.

Housing

Outside of the urban core, much of the Boston region is auto oriented and suburban, but Somerville reflects its urban location and history. Currently, over 90 percent of all housing units in the city were built before WWII, compared to just over 33 percent in the region. Because of this, transit zones in Somerville are more comparable to each other and other inner region locations than they are like the rest of the region. Densities around transit zones across the city are around 30 units per acre and the percentage of renters is high (approx. 70 percent). This coupled with the vacancy of 2.8 percent leaves residents vulnerable to displacement when values rise (CTOD 2008, 7).

Figure 8.1 Land Value Assessments in Somerville Transit Radii

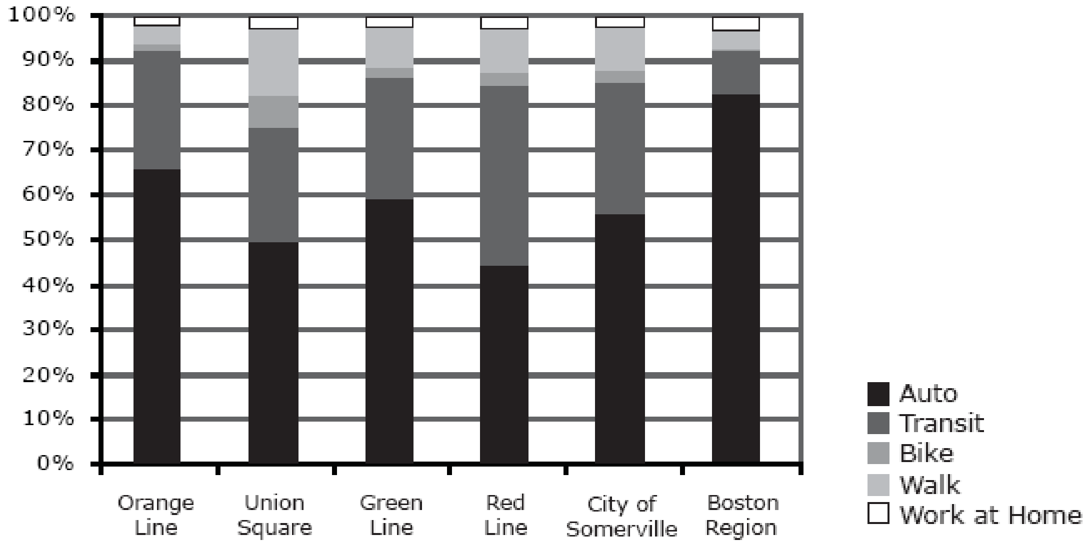


Source: CTOD

Somerville residents are more diverse than its surrounding city. There are a number of different ethnicities and income levels. Median Household Income in the transit zones ranges from $35,000 to $55,000 pointing out that this area is anything but homogeneous. The most vulnerable demographic in Somerville is its low income citizens. If housing values were to rise due to an expansion of transit, low income populations could experience gentrification.

Currently, 40 percent of Somerville residents in the vicinity of the Massachusetts Bay Area Transit Authority (MBTA) red line commute to work while the orange line areas are around 26 percent transit usage. This lower usage may be due to the relatively poor pedestrian and bicycle access to the Sullivan square station and/or residents having jobs in employment centers not served by transit.

Figure 8.2: Journey to Work, 2008



Source: 2008 Journey to Work Survey

Table 8.2: Growth in Incomes 1990-2000

	1990	2000	Increase	Increase Relative to Regional Median
Boston Region	$40,666	$52,792	30%	-
Somerville	$32,455	$46,315	43%	114%
Redline Stations	$34,994	$55,844	60%	172%
Orange Line Stations	$27,462	$37,797	38%	85%

Source: CTOD

Parking

Within Somerville's zoning ordinance are specific parking regulations for zoning districts. The parking regulations (Appendix A) are catered toward auto-oriented development. The parking ratios, although low comparatively to suburban development, are high for a region containing a high level of transit service. Listed in section 9.6.3. of the city ordinance is a Proximity to Rapid Transit or Public Parking regulation. It states: all uses, other than residential, located in proximity to rapid transit and/or municipal parking facilities shall be entitled to a reduced parking requirement (but not a reduced loading bay requirement) based on the following criteria:

A. Uses within six hundred fifty (650) feet of municipal parking garages or lots shall be entitled to a ten percent (10%) reduction in required parking. This shall be computed by application of the normal unit(s) of parking measurement of Section 9.5 to determine the normal requirement, including any fractional requirement, and then multiplying this number by a factor of 0.90.

B. Uses within one thousand (1,000) feet of a rapid transit station shall be entitled to a twenty percent (20%) reduction in required parking. This shall be computed by application of the normal unit(s) of parking measurement of Section 9.5 to determine the normal requirement, including any fractional requirement, and then multiplying this number by a factor of 0.80.

In addition, when a use is located within six hundred fifty (650) feet of a municipal parking garage or lot and within one thousand (1,000) feet of a rapid transit station, said use shall be entitled to a twenty percent (20%) reduction. In no case shall parking requirements be reduced by more than twenty percent (20%) unless specifically authorized by special permit under another provision of this Article.

Issues pertaining parking reduction allowances involve Somerville's transit catchment radius and the minimum parking percentage requirements. Firstly, the radius does not equal a quarter mile. In addition, a 20% reduction in parking is meager given the proven discrepancies of ITE based government parking regulations and actual transit-oriented development parking needs. Parking could potentially be reduced up to 50% the current regulated minimum parking allotment and have an extended radius of 2640 feet. This would allow for higher density, cheaper, developments within all transit stations in Somerville.

Davis and Porter Square, Somerville, MA

Overview

The biggest and longest of Boston's rapid transit lines evolved from a proposal to expand the Main Line Elevated (Orange Line) to Cambridge and South Boston in the early years of the 20th Century. As the experience of operation amassed, several drawbacks were noted. Principal among these were the limitations imposed by an elevated structure zig-zagging around Boston's narrow, crooked streets. The size and capacity of the cars was limited, and the speed of operation was slowed by the sharp curves. Lastly, the elevated structure itself was not highly welcome in the neighborhoods it served. The Washington Street Tunnel, opened in 1908, proved that a direct route vastly improved the service operated, and planning began for a line which would be free of sharp curves and served by the largest subway cars in the world.

The line was built in five stages over a period of almost 75 years. The first section built between 1909 and 1912 had 4 stations, three in Cambridge plus one in Downtown Boston and connected Harvard Square to Park Street (Under). Two more stations were added to this section, a special service station in Cambridge in 1912 and a regular stop in Downtown Boston in 1932. The second phase was built between 1912 and 1918, and was known as the Dorchester Tunnel despite the fact that is ended short of its namesake community. This section added four stations to the route, two in Downtown Boston and two in South Boston. A further addition, built between 1924 and 1928, known as the Dorchester Extension, was the first to reuse a former railroad right of way, and added five stations to the line, all in Dorchester. No further changes were made until 1966, when work began on the South Shore Extension. This project, which took almost 20 years to plan and another 20 to construct, added five stations, four in Quincy and one in Braintree. The final addition, the Northwest Extension added only three new stations, two in Cambridge and one in Somerville, but required the relocation of the original Harvard terminal, and the construction of two temporary stops. Construction began in 1979 and was completed in 1985. Stations on the extensions were opened as they were completed, with the maximum number opened at any one time being 3.

The initial construction of this line marked the initial move away from the systems designed to be compatible with the original elevated systems in Boston, Brooklyn, Chicago, Manhattan and Philadelphia, The new lines built under the Dual Contracts in New York and under Broad St. in Philadelphia would follow this new trend, as would the systems developed in many cities in the second half of the 20th century. The cars designed for the Broad Street line would closely resemble the Boston cars, while the BMT Standards in New York would take on their own unique appearance while adding some interesting twists to the basic layout.

Davis Square is located in the Freight Cut-off right of way which crosses the intersection of Highland Av., Holland and Elm Sts The fare control is on a gallery mezzanine above the inbound track at the center of the platform, and is connected to the platform by stairs, elevator, and escalator. Street exits are at Holland St. to the west and College Av. to the east. Trackway walls are a brown brick, while the ceiling is plain concrete. A combination of descending track grade, and rising local topography place the roadbed low enough for deep bore tunneling at the east end of the platform and this method is used for the next two stops. This station serves nearby Tufts University.

Porter Square is the deepest station below street level on the system. The station has several levels.   There is an entrance lobby at street level with stairways down to a pair of commuter rail platforms one level down and via the usual three modes to a fare control lobby north of the commuter rail tracks at the same level. The glass head house at the street features a steel wind-operated sculpture which resembles hot air balloons, and the Route 77A - Harvard to North Cambridge trolleybus line serves the station. The MBTA commuter rail stop has two tracks with side platforms in an open cut east of Massachusetts Av., but here we are mostly concerned with the subway station.

From the fare lobby, escalators and elevators provide the primary access to the subway platforms with the nine flights of stairs intended for emergencies only. The inbound platform lies above the outbound one with fully accessible connections between them. The inbound (upper) level is approximately 85 feet below the surface, with the outbound (lower) level approximately 100 feet below. From the upper level one can look down over a balcony railing to the lower level platform and track. Not too many rapid transit stations are built like this, and Boston has two! (Harvard is the other, and Rosslyn station in Washington D.C. is another.) Both levels share a single tube of about 40 feet in diameter. The inner surface of the station tube is covered with perforated metal panels, painted an off white. Various points around the station are adorned with bronze castings of discarded gloves.

From here the twin tubes follow the path of Massachusetts Av. passing through bedrock before emerging just below the surface near Garden St. Before entering Harvard station, the line curves around the portal of a second cut-and-cover subway which is part of the Harvard complex.

Parking/Demographic Analysis

The redline station areas once reflected the demographics of the city however, since the opening of the Red Line station in 1986, they are now similar to the region in terms of income and property values. In the 1990 census, the tracts that roughly line the red line station areas had median household incomes approximately 8 percent higher than the City of Somerville as a whole. In 2000, the Red Line stations had median household incomes approximately 21 percent higher than the City. In 2004 the average cost per residential square foot was $73 versus $59 in the City of Somerville as a whole. It is possible that the cause of this jump is the result of Davis and Porter stations presence. Within a quarter mile of Davis Station there are a total of 6,762 households with 14.43 households per acre. The journey to work survey results show that 49.68 percent of residents within a quarter mile of the station commute to work by transit.

Although commute to work transit ridership is fairly higher around The Red Line station than other studied station areas, it still contains higher automobile ownership. The density of the two red line stations are not higher than orange line either. Additionally it contains the most expensive housing and most gentrified of the case studies examined.

Table 8.3: Residential Density and Mode of Commute to Work by ½ of Transit Stations

	Housing Density		Journey To Work: 2000		
Transit Stop	Total households	Household density per acre	Workers 16 years and over: Total	Percent who take Public Transportation	Percent who take Public Transportation, bicycle, or walk
Davis Square-	6,762	14.43	9,832	39.03%	49.68%
Porter Square-	8,045	16.54	11,127	34.00%	50.87%
Sullivan Square-	2,571	15.83	3,137	25.96%	32.39%

The land use mapping of Somerville (Appendix B) displays underutilized land which serves as a void in the connectivity of the landscape. In addition to taking up space that could be utilized as residential or commercial use, it deters multimodal opportunities. Much of the underutilized land contains parking lots which encourage the use of single occupied automobiles. This makes the case that comparing underutilized land around the area of the orange line stations to the red line stations displays a cause of lower transit ridership on the orange line. There is higher density surrounding Davis Square than Sullivan Square. Underutilized is much lower around the red line while figure 8.2 shows a heightened number of riders. The negative relationship between transit ridership and underutilized land is quite apparent.

Orange Line: Sullivan Square, Somerville, MA

Overview

The Orange Line has seen the most dramatic changes over the past 20 years than any other of Boston's transit lines. Once known as the Main Line El, the Orange Line consisted of an elevated line from Everett, through Charlestown, and entered a shared portal with the Green Line at North Station. It then exited the subway in Chinatown, and proceeded as an elevated line over Washington Street through the south end, about four miles to Forest Hills. The elevated lines were once connected to another defunct elevated line over Atlantic Ave., which skirted Boston harbor.

Before the Washington Street Tunnel was built, the Main Line El trains shared part of what is now the Green Line subway with the trolleys. Platforms were raised in certain parts of each station to allow for both street cars and El trains. Trains connected to the northern and southern elevated lines via this tunnel and/or the Atlantic Ave El. This procedure ended with the construction of the Washington Street tunnel through downtown in the early 1900's. This tunnel connected with the Washington Street elevated in Chinatown, ran under downtown, and exited along side the current Green Line in the north end of Boston. In the 1940's, the Atlantic Ave. El was torn down due to low ridership. This made the Washington Street tunnel the only connector between the north and south elevated. Photos of the demolished elevated portion are included in the photo gallery.

There were plans to extend the line from the northern, and southern elevated, but those was scrapped, in favor of a decision to tear down the remaining elevated lines. The northern portion of the El was removed in 1975, when a new northern Orange Line was constructed along a Boston & Main rail route, into Somerville. This line was later extended into Malden. This new line was much faster and more reliable than the old elevated line. The extension ran through a new length of subway under the Charles River, exiting out of a new portal on the other side. For now, Green Line cars still use the old portal, but the "Big Dig" and North Station renovation projects will eventually see the old Main Line El portal completely abandoned.

In 1987, the southern elevated was removed when the new southwest corridor opened, completing the new Orange Line project. This marked the end of heavy rail elevated lines in Boston. There is very little evidence left of the elevated. The only original part of the Orange Line is the subway tunnel through downtown. Extensions were also envisioned with these new lines. The Orange Line would be extended further north and south. The MBTA thought of using overhead wires on these proposed lines, and provisions were made for this on new equipment. But commuter rail already serves these areas, and so these ideas were put on hold.

The orange line contains a few expansion proposals. One is the Washington Street Service. The Orange Line elevated over Washington Street was demolished in 1987 after the southern end of Orange Line was relocated. Since then, the MBTA has promised to restore some type of replacement service. Right now, several bus routes make up for the lost elevated service. But residents of the area want direct service once again, as they had with the "El". When the elevated was to be demolished, residents even asked if the northern part of the el could be retained until replacement service was found. But track and tunnel connections would not allow this.

Several proposals have been on the boards to furnish a direct transportation route from Washington Street to downtown Boston. One was a light rail extension of the Green Line. This would use a dedicated route in Washington St., and enter the unused Tremont Street subway tunnel. This route could even be extended further southward and bring rapid transit into areas that have never had it before. Another proposal was to use trackless trolleys along the same route.

Analysis

The orange line residents are susceptible to long-term change due to its lower incomes and land values, and the presence of 2- and 3-family houses, which can be quickly converted from rentals to condos (CTOD 2008). Lager household sizes, lower incomes, and a higher non white population suggest that this area of the city has some of the most vulnerable populations for displacement. However, the air quality and environmental impacts of the McGrath Highway and I-93, low real estate values, and prevalent industrial uses may have insulated quality of life for current residents.

Table 8.4: Residential Types by Station Area Somerville, MA

	Green Line Extension	Red Line Stations	Orange Line Stations	City of Somerville
Total Housing Units (2000)	19,859	7,793	2,480	32,477
% of units in 1-family structures	8.10%	7.30%	6.10%	7.40%
% of units in 2 or 3 family structures	60.60%	69.30%	51.40%	59.10%
% of units in 4+ family structures	31.30%	23.40%	42.50%	33.50%

Source: CTOD 2008

The Orange line stations contain the most underutilized land currently, and the largest parcels, although most of this land is currently in industrial use, and may continue to be productive economically even as the building value is exceeded by the land value.

The orange line station areas also have the lowest current transit, bike, and walk commute share of any of the studied areas, despite the presence of the Sullivan Square T station. The access issues both within the neighborhood and in connecting to other parts of the city probably limit the attractiveness of transit, walking, and biking, and the access to employment destinations provided by I-93 probably makes driving somewhat more attractive, despite the traffic congestion.

CHAPTER 9

CONCLUSIONS/BEST PRACTICES, LESSONS LEARNED

The Massachusetts Bay Transit Authority's regional transit system is one of greater Boston's biggest regional assets. The region has excellent transit coverage, and improvements are constantly being made to the system. An examination of historical and theoretical transportation trends throughout the history of the United States displays an evolutionary mode shift. While people primarily traveled by foot and mass transportation, the bicycle marked the transition of transportation infrastructure shift from pedestrian to personal vehicle usage. Following the mode shift transition are key events in government infrastructure financing policy supporting the use of personal automobiles. The massive financing of the automobile caused a shift in land use as well. Communities have become more spread out and the need for and expectation of automobile infrastructure has increased due to a decrease in available transit systems and walkability within communities.

Federal, State, and Local government has implemented a policy over the past century following a path which is unstable and unsustainable. Socially, people tend to enjoy driving a car. It has become a major part of American culture. As the world slowly recognizes its rights and wrongs, it's the responsibility of planners to question the trends, analyze the history and evolution of the problem, and propose lessons learned and best practices for moving forward. History shows that walking by foot was Boston resident's first and primary mode of transportation. Following the invention and popularity of the bicycle, land use patterns and technology became intertwined. As technology evolved, so did Boston's settlement pattern. What used to be boat rides across open water and bicycles throughout the city have become bridges across water and automobiles through the city. Sprinkled through history are mass transit and its struggles to be profitable, reliable, and accessible. As transit and highway projects clash for federal funding, a deteriorating highway network is pushed to its capacity on a daily basis. Environmental, economic, and safety concerns are all on the table while discussing the downfalls of automobiles.

A common trait of urban growth is the inclusion of infrastructure specifically focused on accommodating automobiles. Parking is one of these traits. It is tied into development regulations, requiring developers to supply parking in accordance with demand estimates. The estimates are derived from ITE indexes that are based on out of date parking practices and have shown to overestimate demands by as much as 50%. The problems associated with excessive parking supplies within an urban setting are great. Parking, given its automobile focus, disrupts connectivity, decreases density, increases development costs, decreases transit ridership, and decreases housing affordability.

Previous studies show the presence of transit stations that operate at a proficient service level have the ability to decrease the amount of commuters who travel to work by automobile and increase alternative methods of travel. Through examination of urban design standards around a transit station, an acceptable walking distance is ½ mile. Given the information, reductions in parking is advantageous for communities containing an extensive transit system within a ½ mile.

There are many developments in land use management with respect to sustainability that have the ability to decrease automobile oriented land uses. Strategies such as eliminating minimum parking requirements, creating parking benefit districts, creating TOD zoning districts, restricting parking, metering existing parking, and value capture, are all successful.

A critical factor in determining a corridor's ability to evolve into a more transit supportive environment is the amount and type of underutilized or potentially remediated land in proximity to stations (Pollack, 2006). In order to properly manage land uses surrounding transit stations, land use planners must be aware of the pit falls auto-oriented parking policy creates. Policies such as replacement parking, employer paid parking, and minimum parking requirements inhibit the goals and objectives of transit-oriented development. These can be overcome by making local planners and transportation planning agencies such as the Boston Metropolitan Planning Organization and the Massachusetts Executive Office of Transportation aware of opportunities to increase mobility while encouraging adaptive reuse of parking lots.

The local government of Somerville, MA should be sensitive to its housing prices while considering planning for future transit station expansions such as the Green Line Expansion. There is obvious potential for repeating the transition which the Red Line made in the areas surrounding the proposed Green Line stations. It is encouraged that Somerville, MA explore the possibility of including a TOD zoning amendment which requires lower parking requirements and parking meters. Additionally, it is encouraged to include options such as ride sharing and zip car parking spaces to further decrease the land use/parking space ratio. Additionally, it is advisable to encourage local businesses to become properly educated on multi-modal commuting incentives. Employers who subsidize automobile commuting and provide free parking spaces are enticing single occupied automobile commuting patterns while deterring the workforce from making use of a highly efficient and cost effective transit system.

Although reforming parking regulation policies and strategies may not be the end-all-be-all to single occupied automobile travel, it has the potential to decrease the effects created by it. By recognizing the ridership patterns of land uses located within a half mile radius of transit stations, there is potential to increase housing availability and decrease housing prices, automobile ownership, and over-reliance on the highway system.

APPENDIX A

PARKING ORDINANCE FOR SOMERVILLE, MA

Section 9.5. Number of parking Spaces.

The number of parking spaces indicated for the corresponding types of uses shall be provided in all zoning districts, except the University District, the ASMD and the PUD-A districts, and as otherwise indicated.

Note: § 9.5 was amended by Ordinance 2004-04 on April 22, 2004.

The symbols under the column parking factor shall mean:

s.f.: square feet of net floor area, unless otherwise specified

NOTE: THE FOLLOWING TABLE IS STRUCTURED TO COINCIDE, TO THE DEGREE PRACTICAL, WITH THE FORMAT OF THE TABLE OF PERMITTED USES IN ARTICLE 7. PLEASE REFER TO SECTION 9.14 FOR PARKING REQUIREMENTS IN THE UNIVERSITY DISTRICT.

TABLE INSET:

TYPE OF USE			PARKING FACTOR (Minimum number of parking spaces to be provided)
1)	Residential Uses:		
	a.	Dwelling unit in: single-, two-, or three-family dwelling, townhouses, multiple dwelling building, or mobile home, unless specified differently elsewhere in this Article 1.5 per unit with 1 or 2 bedrooms;	1.0 per efficiency or studio unit; 2.0 per unit with 3 or more bedrooms; plus, in all cases: 1.0 for every 6 units (when 6 or more units) for visitors and/or service vehicles

	b.	Senior citizen housing (including congregate)	0.75 per unit, 0.40 per unit allowable by special permit

2) Special Residential Conversions:

Note: § 9.5.2 was re-titled and amended by Ordinance 1991-1, on January 10, 1991.

a. Existing 1 and 2 family residences converting to 2 or 3 family residences shall provide one (1) parking space per additional (e.g. newly created) dwelling unit. Also note that the provisions of Section 9.4 as to nonconformity with respect to parking are likely to apply in many instances.

EXAMPLE: A single family home is converting to a 2 family residence. One (1) space is required for each new dwelling unit created in the conversion. If the single-family home is converting to a 3 family residence, then two (2) parking spaces are required for the conversion -- one (1) for each new unit.

Note that this is the parking required for the newly converted unit(s) and is additional parking above what is required for the existing site. However, if the existing lot is nonconforming with respect to parking, then please refer to the special considerations under Section 9.4.1.

b. For other special residential conversions, see the appropriate parking requirement for the type of use that will result from the conversion. Also note that the provisions of Section 9.4 may apply in those situations where there was a prior nonconformity with respect to parking.

TABLE INSET:

TYPE OF USE			PARKING FACTOR (Minimum number of parking spaces to be provided)
3)	Other Residential Uses:		
Note: § 9.5.3 was amended by Ordinance 1991-10 on August 22, 1991.			
	a.	Boarding house	1 for each 3 bedrooms

	b.	Homeless shelter	1 for each employee on the largest shift
	c.	Community or group residence	2.0 per dwelling unit
	d.	For those uses not listed here, refer to Categories 1 and 5 of this Section.	
4)	Accessory Residential Uses:		
	a.	Tourist home rooms	1 for each 3 rooms (units) for lease
	b.	Professional office	see Office (Category 7)
	c.	Daycare center	see Institutional (Category 5)
5)	Institutional and Educational Uses:		
Note: § 9.5.5 was amended by Ordinance 1991-10 on August 22, 1991.			
	a.	Elementary, secondary school	1.0 per employee
	b.	College, technical school	0.4 per student
	c.	Dormitory, fraternities or sororities	0.5 per bed
	d.	Church, temple, auditorium, club, lodge, community center	1 per 6 seats in the main auditorium or assembly area, based on design occupancy
	e.	Public library, art gallery, museum and other non-recreational public facilities	1 per each 600 s.f. of floor area open to the public
	f.	Daycare center	1 per employee when a principal use, 0.5 per employee when accessory use
	g.	Hospital	0.75 per employee plus 1 per bed
	h.	Nursing Home	1 for each 6 patient beds

6)	Recreational Uses:		
	a.	Gymnasium, stadium, field house	1 per each 10 seats
	b.	Athletic fields, pool facilities recreational centers, and related uses	as needed
	c.	Tennis/racquetball	1 per court unless an accessory use, then none required
	d.	Recreational centers and health clubs	whichever is higher: 1 space/500 s.f. gross building area, or 1 space per 4 persons based on occupancy capacity of the largest assembly area
	e.	Marinas and dry boat storage	1 per each 3 wet slips and 1 per each 5 dry storage bays, plus 1 per employee on the site
	f.	Parks/passive recreational	as needed
	g.	Theater, other public assembly	1 per 6 seats
	h.	Bowling alley	1 per employee plus 1 per alley
	i.	Other commercial amusement	1 per 3 persons, based on design capacity of facility, plus 1 per employee

NOTE: PARKING REQUIREMENTS FOR USE CATEGORIES 7, 8, AND 9 BELOW SHALL BE KEYED AS FOLLOWS --

"A" shall indicate the requirement for zoning districts RA, RB, RC, BA, IA, IB, IP & OS

"B" shall indicate the requirement for zoning districts BB

"C" shall indicate the requirement for zoning districts CBD & NB

TABLE INSET:

			A	B	C

7)	Office Uses:				
	a.	Office other than medical	1/500 s.f.	1/350 s.f.	1/575 s.f.
	b.	Medical/dental/veterinarian office, outpatient clinic	1/400 s.f.	1/300 s.f.	1/500 s.f.
8)	Business Service Uses:				
	Business service uses as listed in Part 8 of the Table of Permitted Uses (see Article 7), unless a more specific parking requirement is otherwise noted in Part 7 or Part 15 of this Section 9.5 for a specific use		1/450 s.f.	1/300 s.f.	1/550 s.f.
9)	Retail Sales/Rental Uses:				
	Retail sales/rental uses as listed in Part 9 of the Table of Permitted Uses (see Article 7), unless a more specific parking requirement is otherwise noted in Part 15 of this Section 9.5 for a specific use		1/425 s.f. street level	1/250 s.f. street level	1/500 s.f. street level
			--- 1/1000 s.f. all other floors ---		

Up to five thousand (5,000) gross s.f. of unfinished storage space, accessory top the primary retail floor area, in a Neighborhood Business (NB) District does not require any additional spaces, I order to encourage less frequent deliveries.

Note: § 9.5.9 was amended by Ordinance 2002-6 on August 8, 2002.

TABLE INSET:

TYPE OF USE		PARKING FACTOR (Minimum number of parking spaces to be provided)
10)	Eating/Drinking/Transient Accommodations:	

	a.	Restaurants, other eating or food service use, and bar/tavern without dance floor or staging area	Whichever is greater: - 0.75 per employee plus 1 per 4 seats, or - 1 per 110 gross s.f.
	b.	Take-out food service (when there is no seating)	0.75 per employee plus 1 per 50 s.f. of customer waiting area
	c.	Caterer	whichever is greater: 1 per employee or 1 per 450 s.f.
	d.	Hotel, motel	0.5 per employee on peak shift, plus 0.8 per guest room, plus 1/4 the normal requirement for any other use (both principal and accessory) within the hotel
	e.	Convention center	1 per 4 seats in the largest assembly area, based on design capacity
	f.	Nightclub, bar/tavern with dance floor or staging area	0.75 per employee, plus 1 per 4 persons based on building design capacity
11)	Motor Vehicle Sales/Service Uses:		
	a.	Motor vehicle service uses	2 per first bay, plus 1 per each additional bay, plus 1 per business vehicle stored on-site
	b.	Motor vehicle rental uses	1/1,000 s.f. of customer receiving area, plus 0.50 per employee, plus sufficient space for storage of full rental pool of vehicles
	c.	Motor vehicle sales	1 per 500 s.f.

	d.	Vehicle parts sales	see Retail Sales (Category 9) or Wholesale (Category 13), as applicable
12)	Commercial/Industrial Services:		
	a.	Research/laboratory	1 per 750 gross s.f. building area
	b.	Warehouse/distribution	1 per 1,500 gross s.f. building area, plus 1 per business vehicle stored on-site
	c.	All other commercial/industrial services	1 per 650 s.f., plus 1 per business vehicle stored on-site
13)	Wholesale Business Use:		1 per 800 s.f., plus 1 per business vehicle stored on-site
14)	Industrial Use:		1 per 1,000 gross s.f. building area, plus 1 per business vehicle stored on-site
15)	Other Business Uses:		
	a.	Funeral parlors	1 per 4 seats in the largest assembly area, based on design occupancy capacity, plus 1 per business vehicle stored on site
	b.	Kennels	1 per employee, plus 1 per 6 boarding units
	c.	Greenhouse, nursery, roadside stand	1 per 1,000 s.f. of display/sales area, indoors or outdoors
16)	All Other Permitted Uses:		As needed, usually 1 per employee and

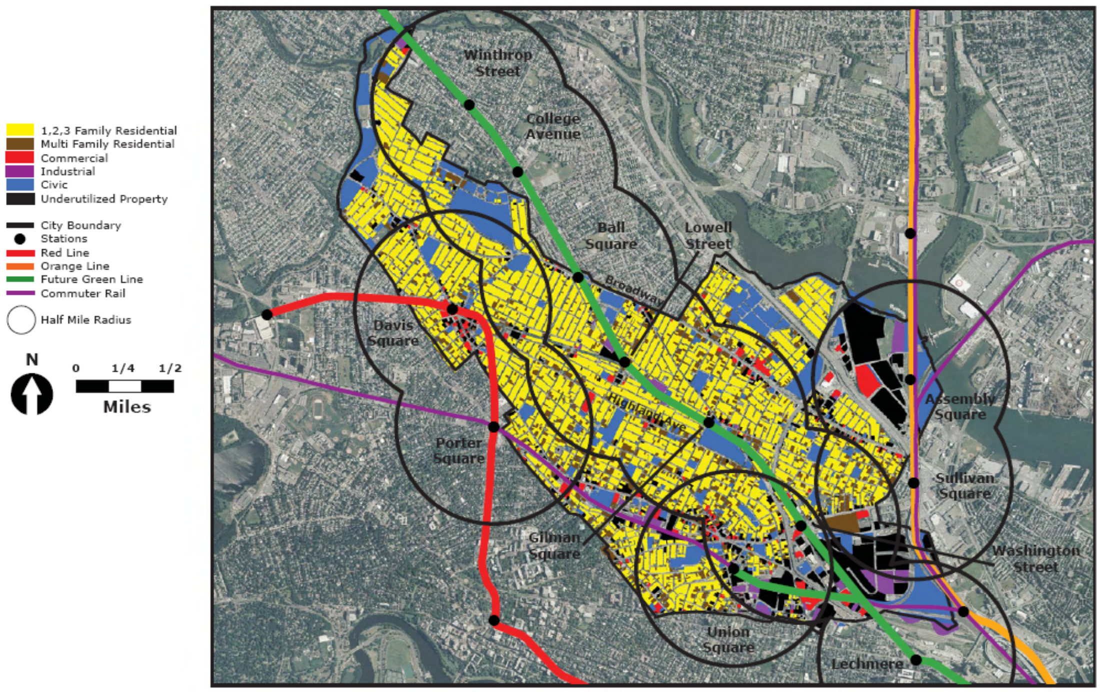
		0.3 per visitor

For specific uses not on the above schedule, the Inspectional Services Superintendent, in consultation with the Traffic and Parking Director, shall determine and apply the unit of measurement in the schedule deemed most similar to the proposed use, or the Superintendent may require parking based on the best available, documentable data.

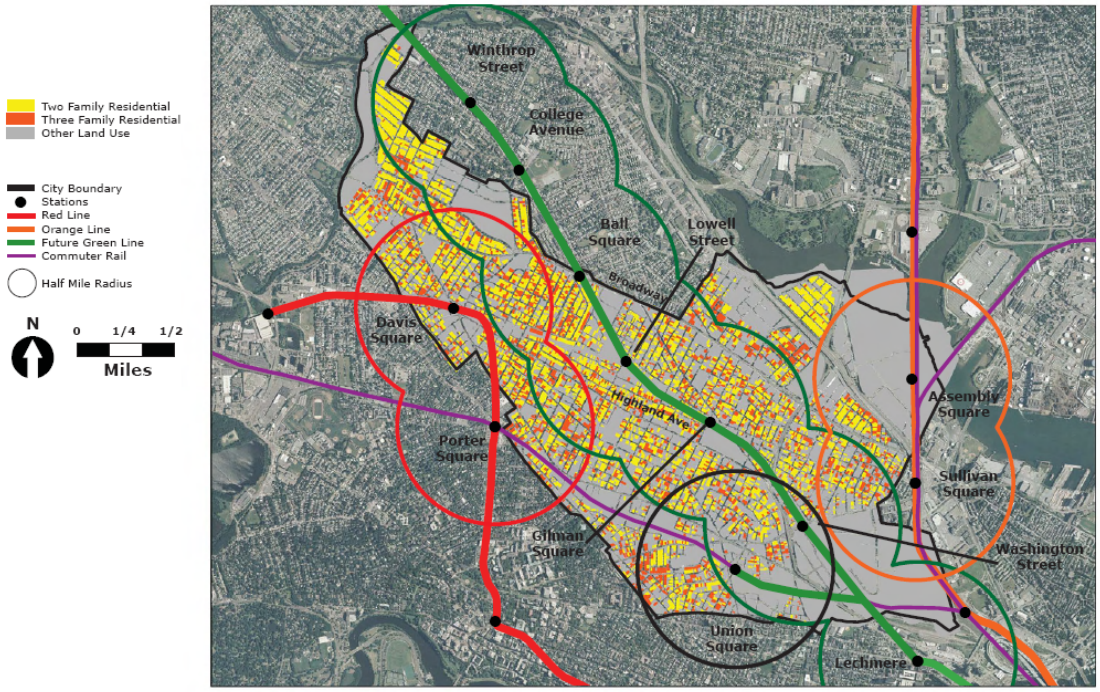
APPENDIX B

CENTER FOR TRANSIT-ORIENTED DEVELOPMENT DEMOGRAPHIC MAPS FOR SOMERVILLE, MA

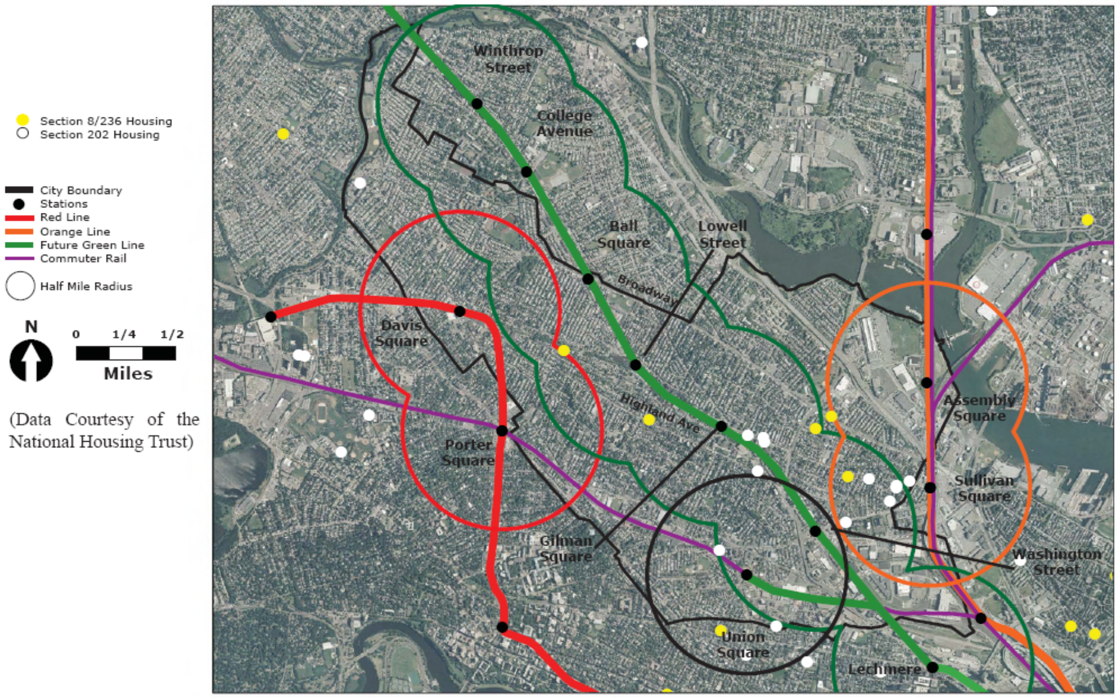
Underutilized Land in Somerville, MA



2-3 Family Unit Housing in Somerville, MA

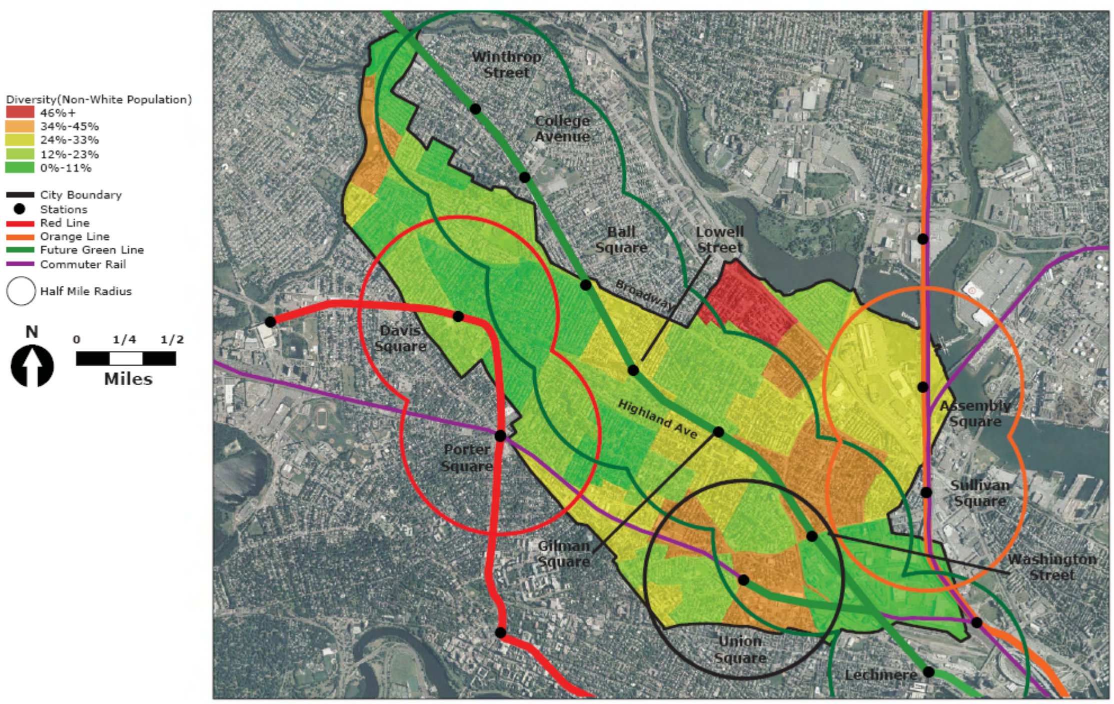


Assisted Housing Units in Somerville, MA

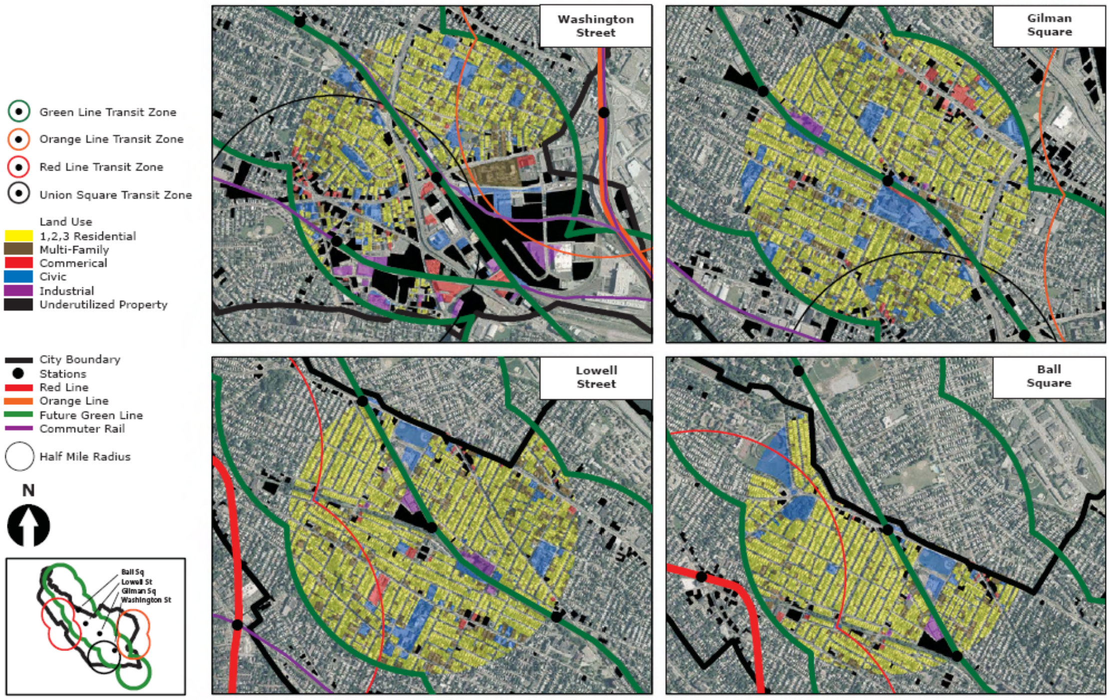


(Data Courtesy of the National Housing Trust)

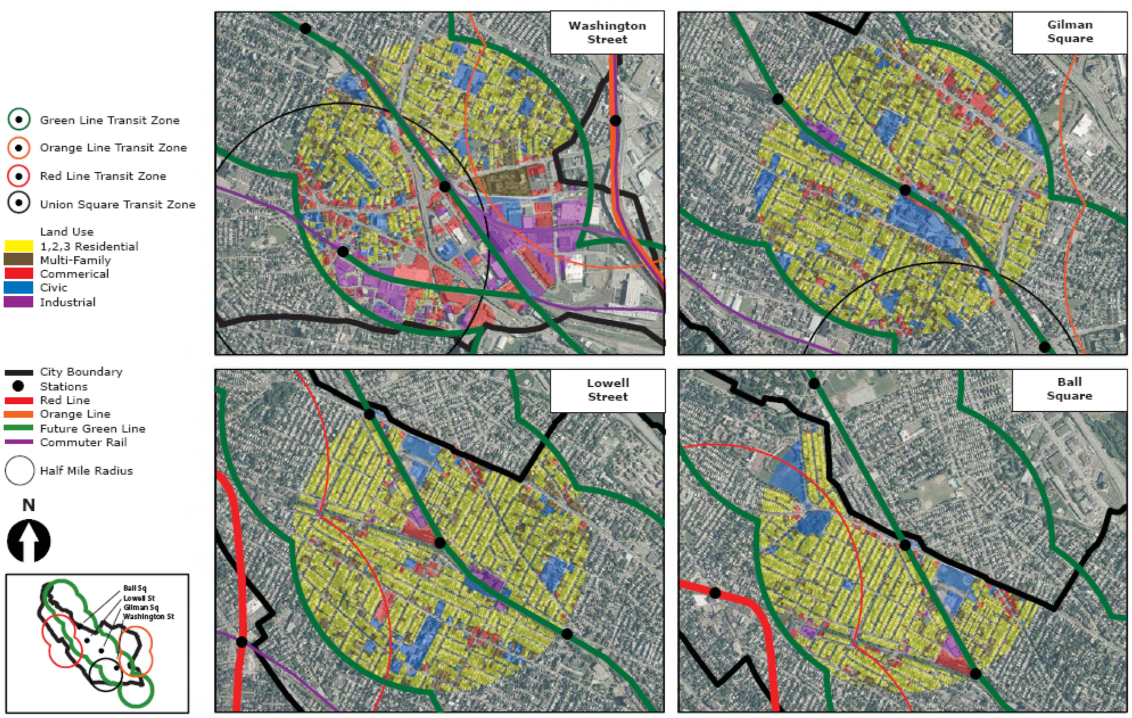
Non-White Population by Census Tract in Somerville, MA



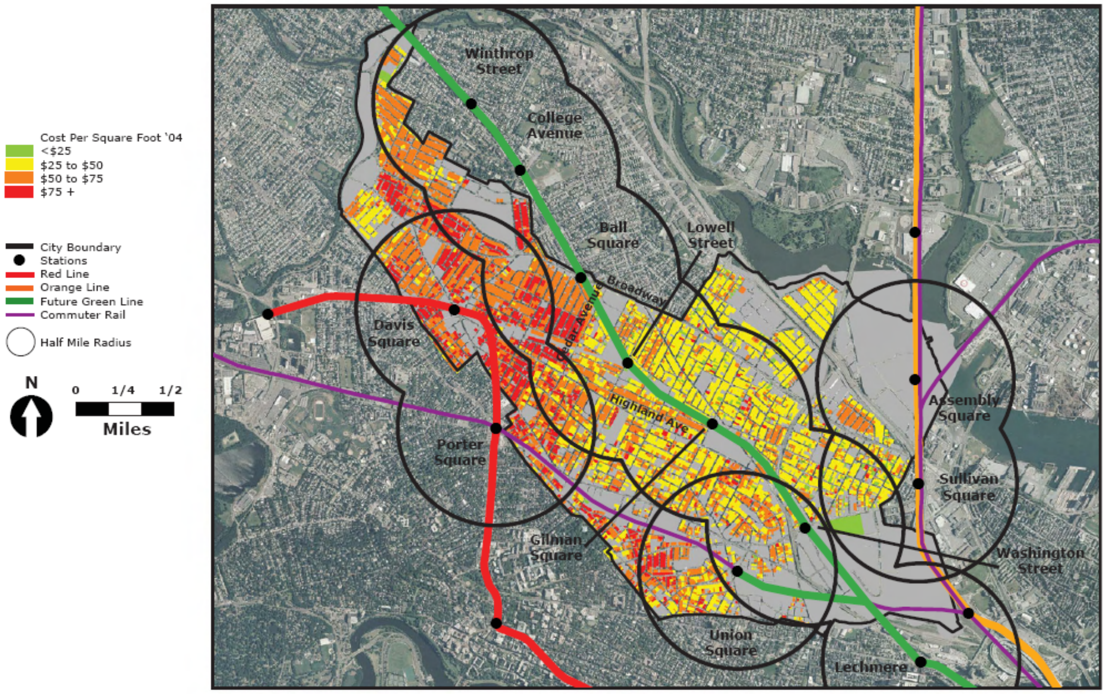
Underutilized Land in Specific Station Areas, Somerville, MA



Green Line Extension Land Use, Somerville, MA



Residential Land Cost Per Square Foot, Somerville, MA



Cost Per Square Foot '04
<$25
$25 to $50
$50 to $75
$75 +
City Boundary
Stations
Red Line
Orange Line
Future Green Line
Commuter Rail
Half Mile Radius
N
0 1/4 1/2
Miles
Winthrop Street
College Avenue
Ball Square
Lowell Street
Broadway
Cedar Avenue
Davis Square
Highland Ave
Assembly Square
Porter Square
Sullivan Square
Gilman Square
Washington Street
Union Square
Lechmere

APPENDIX C

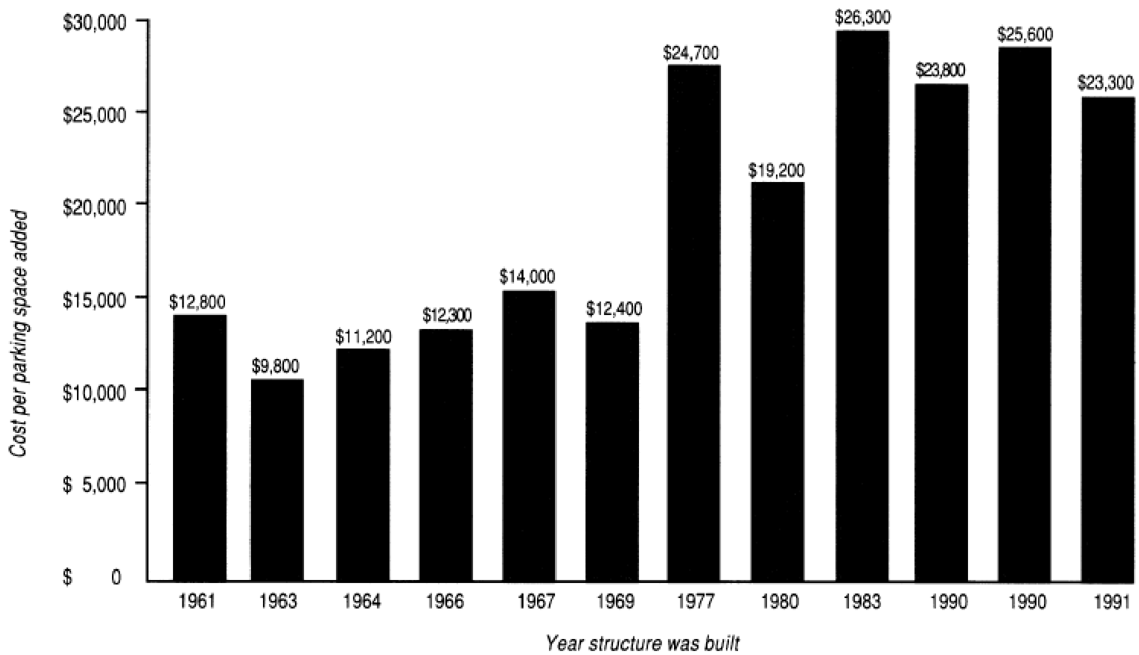
THE COST OF PARKING SPACES ADDED BY 12 PARKING STRUCTURES BUILT AT THE UNIVERSITY OF CALIFORNIA, 1961-1991

Year built	Parking structure	Spaces in structure	Surface spaces lost	Spaces added by structure	Structure cost original $	Structure cost 1994 $	Cost per space added original $	Cost per space added 1994 $
(1)	(2)	(3)	(4)	(5)=(3)-(4)	(6)	(7)	(8)=(6)/(5)	(9)=(7)/(5)
1961	5	765	219	546	$ 1,091,122	$ 6,966,550	$ 2,000	$12,770
1963	14	1,428	355	1,073	$ 1,745,488	$10,476,589	$ 1,626	$ 9,760
1964	3	1,168	213	955	$ 1,859,001	$10,740,676	$ 1,946	$11,246
1966	9	1,800	298	1,502	$ 3,489,706	$18,520,065	$ 2,323	$12,327
1967	8	2,839	666	2,173	$ 6,060,753	$30,517,584	$ 2,789	$14,045
1969	2	2,253	323	1,930	$ 5,610,206	$23,908,098	$ 2,907	$12,389
1977	CHS	921	319	602	$ 7,083,893	$14,871,473	$11,762	$24,693
1980	6	750	200	550	$ 6,326,135	$10,568,750	$11,499	$19,210
1983	4	448	0	448	$ 8,849,000	$11,769,409	$19,752	$26,271
1990	1	2,851	346	2,505	$52,243,000	$59,705,071	$20,859	$23,839
1990	RC	144	53	91	$ 2,040,000	$ 2,331,381	$22,350	$25,542
1991	SV	716	0	716	$14,945,000	$16,715,805	$20,873	$23,346
Total		16,083	2,992	13,091	$111,343,304	$217,091,452		
Average 1961-1991		1,340	249	1,091	$ 9,279,000	$ 18,091,000	$ 8,500	$16,600
Average 1961-1969		1,709	346	1,363	$ 3,309,000	$ 16,855,000	$ 2,400	$12,400
Average 1977-1991		972	153	819	$15,248,000	$ 19,327,000	$ 18,600	$23,600

Table 1. The cost of parking spaces added by 12 parking structures built at the University of California, Los Angeles, 1961-1991.

APPENDIX D

THE COST PER PARKING SPACE ADDED BY PARKING STRUCTURES AT THE UNIVERSITY OF CALIFORNIA , LOS ANGELES (1994)



APPENDIX E

PARSONS BRINKERHOFF STUDY OF EFFECT OF RAIL TRANSIT ON PROPERTY VALUES SUMMARY

SUMMARY of STUDIES: RAIL TRANSIT'S EFFECTS ON PROPERTY VALUES

Rapid/Commuter Rail

Location, (Author, Year Published)	Rail System	Type of Property Studied	Result	Comments[1]
Washington, D.C. (FTA 2000)	Rapid rail: Metro	Commercial	Price per square foot decreases by about $2.30 for every 1,000 feet further from station.	City-wide analysis of over 2,800 commercial properties. Access measured as ground distance to nearest Metro station.
Atlanta (Nelson 1998)	Rapid rail: MARTA	Commercial	Price per square meter falls by $75 for each meter away from transit stations. Price rises by $443 for location within special public interest districts.	City-wide analysis measuring access as ground distance to a MARTA station. Study also looked at the effects of special policy districts.
San Francisco (Lewis-Workman and Brod 1997)	Rapid rail: BART	Residential	Average home prices decline by about $1,578 for every 100 feet further from station.	Study area defined as one-mile radius from a single station area (Pleasant Hill). Access measured as ground distance to station
New York (Lewis-Workman and Brod 1997)	Rapid rail: New York City MTA	Residential	Average home prices decline by about $2,300 for every 100 feet further from the station areas.	Study area defined as one-mile radius from three different station areas (Forest Hills, 67 Avenue, and Rego Park). Access measured as ground distance to station.
San Francisco Bay Area (Landis et al. 1995)	Rapid rail: BART	Residential and Commercial	1990 single family home prices decline by $1.00 to $2.00 per meter of distance from a BART station in Alameda and Contra Costa Counties. Found no effect for commercial property.	For residential study, measured ground distance to BART stations. Also looked at nuisance values of being adjacent to line and found none. Commercial property observations have significant data problems
San Francisco Bay Area (Landis et al. 1995)	Commuter rail: CalTrain	Residential	Did not find a significant impact on house values from proximity to a rail station. Houses within 300 meters of a CalTrain right-of-way sold at a $51,000 discount.	Access measured as ground distance to nearest station.

Rapid/Commuter Rail, continued

Location, (Author, Year Published)	Rail System	Type of Property Studied	Result	Comments[1]
Washington, D. C. (Benjamin and Sirmans 1996)	Rapid rail: Metro	Residential, Apartment Rents	Rents decrease by 2.4 to 2.6% for each one-tenth mile increase of distance from a Metro station.	Study looked at over 250 rental observations from 81 apartment complexes. Access measured ground distance to nearest station.
Boston (Armstrong 1994)	Commuter rail: MBTA, Fitchburg Line	Residential	Single family residences located in communities that have a rail station have a market value approximately 6.7% greater than those that do not. Also found a property value loss of about 20% for properties located within 400 feet of a commuter or freight rail right-of-way.	Study area was defined as municipalities that fell more than 50% within an area approximately 10 miles from line. Study focused on station areas as well as right-of-way (nuisance) impacts. The nuisance impact may be the result of proximity to freight rail rather than commuter rail.
Los Angeles (Fejarang et al. 1994)	Rapid rail: Metro Rail	Commercial	Commercial space within ½-mile of the rail corridor had an additional $31 increase in mean sale price per square feet over the mean sales price of a comparable control group outside of the rail corridor, between 1980 and 1990.	Studied the effects of the announcement of coming rail service using a test and control group method to compare properties within the corridor to similar ones without.
Philadelphia (Voith 1993)	Rapid rail: SEPTA	Residential	Finds a premium for single family homes with access to rail stations of 7.5 to 8.0% over the average home value.	Access to rail defined according to proximity of a given house to train service, measured in census tracts.

Light Rail Transit

Location, (Author, Year Published)	Facility Characteristics	Type of Property Studied	Result	Comments[1]
Santa Clara, County (Weinberger 2001, 2000; Cambridge Systematics, Inc. 1999)	LRT: Guadalupe line	Commercial	Commercial space within a ¼-mile of a station received an average of 2.3¢ to 5.0¢ more per square foot than space located more than ¾-mile from a station. Office space sold within a ¼-mile of a station received an average of $4.87 per square foot more per gross building square foot compared to space located more than ¾-mile from a station.	County-wide analysis. Access to transit measured as ¼-mile distance rings.
Portland (Dueker and Bianco 1999)	LRT: MAX, Eastside line	Residential	Median house values increase at increasing rates as move toward an LRT station. The largest price difference ($2,300) occurs between the station and 200 feet away.	Study used a test and control group method to compare property values along a parallel bus corridor to those along the rail line.
Portland (Chen et al. 1998)	LRT: MAX, Eastside line	Residential	Beginning at a distance of 100 meters from the station, each additional meter away from decreases average house price by $32.20.	Update of the 1993 study, with a slightly altered study area (including extending the area of influence to 1000 meters)
Portland (Lewis-Workman and Brod 1997)	LRT: MAX, Eastside line	Residential	On average, property values increase by $75 for every 100 feet closer to the station (within the 2,500 ft. – 5,280 ft. radius).	Study area defined as the area within a one-mile radius, but 2,500 feet away, from three station areas (148th Ave., 162nd Ave., and 172nd Ave.). Access measured as ground distance to stations.
Portland (Knaap et al. 1996)	LRT: MAX, Westside line	Residential	The values of parcels located within ½-mile of the line rise with distance from the lines, but fall with distance from the stations.	Study looked at property values in advance of the Westside LRT beginning operations. Study area included land within two to three miles of the line in Washington County. Access measured as ½-mile distance ring.
San Diego (Landis et al. 1995)	LRT: San Diego Trolley	Residential and Commercial	The typical home sold for $272 more for every 100 meters closer to a light rail station. No effect found for commercial impacts	City-wide analysis, access based on ground distance to station

Light Rail Transit, continued

Location, (Author, Year Published)	Facility Characteristics	Type of Property Studied	Result	Comments[1]
Sacramento (Landis et al. 1995)	LRT: Sacramento Light Rail	Residential	No effects found	City-wide analysis, access based on ground distance to station
San Jose (Landis et al. 1995)	LRT: San Jose Light Rail	Residential	The typical house was worth $197 less for every 100 meters it was closer to light rail.	City-wide analysis, access based on ground distance to station. Light rail located in commercial, industrial area. Nearby homes are older and serve a lower income households.
Portland (Al-Mosaind et al. 1993)	LRT: MAX, Eastside	Residential	The typical house sold for $663 more for every 100 feet nearer a light rail station.	Study conducted in suburban residential area with seven stations. Only home sales within walking distance (1/4-mile) of stations were analyzed.

[1] Three methods of measuring distance are referred to in this column. "Ground distance" refers to the distance traveled on the ground (i.e., by walking, riding a bike, or driving). This is contrasted to "air distance" which measures a straight-line from the property in question to the transit station. This second method is less precise in measuring actual access to stations. A third method involves the use of rings circling a transit station (usually divided into ¼- and ½-mile segments). All properties within each ring are considered as having the same access.

BIBLIOGRAPHY

Anas, A. et al. "Land Values and Transit Access: Modeling the Relationship in the New York metropolitan Area, An implementation handbook, U.S. Federal Transit Administration.

Barr, Mary *Downtown Parking Made Easy: 6 steps to improving the quality and quantity of downtown parking.*

Belzer, D. and G. Autler. *Transit-oriented development: moving from rhetoric to reality*. Washington: Brookings Institution Center on Urban and Metropolitan Policy and the Great American Station Foundation. 2002.

Bernick, Michael and Cevero, Robert. 1997. *Transit Villages in the 21st Century*. McGraw-Hill Companies.

California Department of Transportation (Caltrans). 2002. Statewide Transit-Oriented Development (TOD) Study: Factors for Success in California: Special Report on Parking and TOD: Challenges and Opportunities.

Calthorpe, Peter. 2001 *The Regional City: Planning for the End of Sprawl.* Island Press. Edited by Robert Fishman. P. 243-270.

Central Transportation Planning Staff. Mobility in the Boston Region: Existing Conditions and Next Steps. Boston, MA 2004

Center for Transit-Oriented Development and Center for Neighborhood Technology. *The Affordability Index: A new Tool for Measuring the True Affordability of a Housing Choice.* Urban Markets Initiative. January 2006

Center for Housing Policy, October 2006. A Heavy Load: The Combined Housing and Transportation Burdens of Working Families.

Center for Transit-Oriented Development May, 2008. *Somerville Equitable Transit-Oriented Development Strategy*. Reconnecting America.

Center for Transit-Oriented Development (CTOD). *Capturing the Value of Transit* Prepared by The United States Department of Transportation Federal Transit Administration. (November 2008)

Childs, Mark, *Parking Spaces: A design, Implementation, and Use Manual for Architects, Planners, and Engineers.* McGraw-Hill (1999)

Commonwealth of Massachusetts Office of Commonwealth Development. “Six principles for transit-oriented development,” *2006 Massachusetts Smart Growth Conference*. Worcester. December 2006

Day, Kristen. 2007 Remaking Minnie Street: The Impacts of Urban Revitalization on Crime and Pedestrian Safety. Journal of Planning Education and Research (26): 315-331.

Edwards, John D. *Parking: The Parking Handbook for Small Communities.* Institute of Transportation Engineers, National Main Street Center, National Trust for Historic Preservation.

Fink, James. *The Automobile Age*. The Massachusetts Institute of Technology Press. 1990

Gerard C.S. Mildner, James G. Strathman, and Martha J. Bianco. *Travel and Parking Behavior in the United States.*

Goodman, Robert. May 2008 *The Truth About Sustainability: History tells us that smart cars won’t solve all our problems.* American Planning Journal. P. 13

Goodwill, Julie and Sara J. Hendricks. *Building transit-oriented development in established communities*. Tampa. October 2002.

Kodama, Michael and Francis, William & Associates. *Using Demand-Based Parking Strategies to Meet Community Goals.* The Mobile Source Air Pollution Reduction Review Committee (MSRC) under the AB2766 program. 1993

Kunstler, James Howard. The geography of nowhere : the rise and decline of America's man-made landscape / James Howard Kunstler. New York : Simon & Schuster, c1993.

Kuzemka, Katherine. “Measuring Your Parking Meter Program.” *The Parking Professional,* November 1997, pp. 16-23.

Leinberger, Christopher. *Financing Progressive Development.* Brookings Institute July 1, 2008.

Lewis, D. et al. Policy and Planning as Public Choice: Mass Transit in the United States, 1999.

Metropolitan Transportation Commission. 2006. Characteristics of Rail and Ferry Station Area Residents in the San FranciscoBay Area: Evidence from the 2000 Bay Area Travel Study (BATS).

Monheim, R, 1996, *Parking Management and Pedestrianisation as Strategies for Successful City Centres,* OECD & ECMT, Sustainable Transport in central and Eastern European cities, Paris, 1996, pp53-143.

Noyes, Pat. *Transportation Tech Sheet: Traffic Calming*. Congress for the New Urbanism. 2008

Pisarski, Allen, Commuting in America III: Third National Report on Commuting Patterns and Trends. Washington, DC : Transportation Research Board, 2006.

Pollock, Stephanie, *On the Right Track: Meeting Greater Boston's Transit and Land Use Challenges.* Urban Land Institute Boston District Council: May 2006.

Reconnecting America. *Preserving Opportunities: Saving Affordable Homes Near Transit.* Washington, DC 2006

Reconnecting America and Center for Transit-Oriented. *Transit and Employment: Increasing Transit's Share Of The Commute Trip.* TOD 202. June 2008.

Shoupe, Donald. *Parking Cash Out.* American Planning Association. Planning Advisory Report Service: Report Number 532. March 2005.

Transit Cooperative Research Program. 2008. *Effects of TOD on Housing, Parking, and Travel*. TCRP Report 108. Transportation Research Board of The National Academies.

Transit Cooperative Research Program. 2004. *Transit-Oriented Development in the United States: Experiences, Challenges, and Prospects.* TCRP Report 102. Transportation Research Board of The National Academies.

Transit Cooperative Research Program. 2006. *Effects of TOD on Housing, Parking, and Travel*. TCRP Report 128. Transportation Research Board of The National Academies.

Transportation Research Board. "The role of transit in creating livable metropolitan communities," *TCRP Report 22*. Washington. 1997.

http://www.municode.com/Resources/gateway.asp?pid=11580&sid=21

ULI-the Urban Land Istitute and NPA- the national Parking Association. *The Dimensions of Parking: Third Edition.* Washington, DC 1993.

Utt, Ronald. *Ending Pervasive Inequalities in Gas Tax.* The Heritage Foundation. June, 16, 2008.

Wilson, Richard 1991. Estimating the Travel and Parking Demand Effects of Employer Paid Parking. Regional Science and Urban Economics 22: 133-145